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A COMPENDIUM OF FISHERIES INDICATORS FOR TARGET TUNA STOCKS IN THE WCPFC CONVENTION AREA

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A compendium of fisheries indicators for target tuna stocks in the WCPFC Convention Area

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WCPFC-SC19-2023/SA-WP-06

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Contents

1 Executive Summary

The principal purpose of this paper is to provide empirical information on recent patterns in fisheries for the SC's consideration. For SC19, we present a compendium of fishery indicators for all 'key' target tuna species (skipjack, bigeye, yellowfin and South Pacific albacore tuna). In 2023, full stock assessments were conducted for yellowfin and bigeye, but not for South Pacific albacore or skipjack. Trends for South Pacific albacore tuna are also described in the regularly requested stand-alone paper: *Trends in the South Pacific albacore longline and troll fisheries* (McKechnie et al., 2023).

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 available from the WCPFC databases as of 11 July 2023. It is difficult to confidently interpret the stock status-related implications of trends in any indicators in isolation from other data sets and a population dynamics model. Therefore, short-term stochastic projections for WCPO South Pacific albacore and skipjack are also presented to assess potential stock status at the end of 2024 in light of recent catch and effort trends.

2 Data and Methods

To track developments in key target tuna species not formally assessed in the current year, a formal request was made to develop stock indicators (Scientific Committee's Work Programme for 2008-2010, Project 24), and these were first reported to SC4 in 2008 (Hampton and Williams, 2008). More recent versions of this now-annual SC paper have addressed the request from SC9 for descriptive text to assist in interpreting the paper contents.

Stock indicators for skipjack, bigeye, yellowfin and South Pacific albacore tuna are presented here. Skipjack had a full assessment conducted in 2022 (Castillo-Jordan et al., 2022); South Pacific albacore was last assessed in 2021 (Castillo-Jordan et al., 2021). This year, bigeye and yellowfin tuna were assessed (Day et al., 2023 and Magnusson et al., 2023, respectively) and will be presented at SC19. Commentary provided in this paper compares the values of various indicators to previous years, in particular comparisons of 2022 values to 2021 and to the average from 2017-2021.

Short-term stochastic projections for WCPO skipjack and South Pacific albacore are included for further information; projections for WCPO bigeye and yellowfin are not provided as assessments are being conducted in 2023 and the final model uncertainty grid has not yet been approved by SC. For WCPO skipjack, projections were from 2021, and for South Pacific albacore from 2019, using the most recent assessments (Castillo-Jordan et al., 2022, Castillo-Jordan et al., 2021). Future recruitments were modelled as deviations around the stock recruitment relationship from the period over which the stock-recruitment relationship was estimated within the assessment model. For each stock, projections were performed over the grid of assessment runs defined by SC17 (South Pacific albacore) and SC18 (skipjack) and results were weighted as defined by the relevant SC meeting. Stocks were projected through 2020, 2021 and 2022 as necessary using actual catch and effort levels in those years, and then through to 2024 assuming 2022 catch and effort levels remained constant. We note that the near-future stock status of most of these stocks will initially be influenced by recent recruitment levels estimated within the stock assessment model, and then by the estimated stock recruitment relationship and random recruitment deviations sampled from the historical period. Those recruitments will take several years to reach the adult biomass, dependent on the species.

Indicators are based on annual catch estimates for the WCPFC Convention Area, 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, descriptive text is tabulated below for each stock.

Please note that the figures here may include or exclude specific fleets that are included in summaries made for other purposes (e.g. CMM tables) and therefore these numbers may not be identical to those produced elsewhere. Furthermore, these numbers will change as more data become available.

3 Note on reduced observer coverage since 2020

Observer coverage levels were greatly reduced in 2020, 2021 and 2022 due to the impacts of COVID-19. As a broad indicator of the impact on observer coverage rates, the purse seine fleet coverage level declined from $\sim$ 90% in 2018-19 to $\sim$ 15% in 2021 and 2022. The decline in longline coverage was from $\sim$ 6% to $\sim$ 3%. Details of observer coverage of fishing effort in the WCPFC-CA are summarized in Panizza et al. (2023).

To estimate the potential errors associated with lower observer sampling rates, Peatman et al. (2022) reviewed potential impacts on purse seine species composition estimates. They determined that catch estimates of bigeye, and to a lesser extent yellowfin, were most sensitive to reduced observer coverage.

Regarding the figures presented and discussed in this paper, the indicators potentially most affected by the reduced observer coverage are the 2020/2021/2022 values for the total purse seine catch and CPUE estimates for bigeye, yellowfin and skipjack. Size distributions of catch may also be affected by the decreased sampling of on-board catch. Longline catch and CPUE are likely less affected.

Acknowledgments

The authors would like to thank Paul Hamer for a careful review of the final draft of this paper.

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Skipjack tuna

Figure	Indicator	Description
Figure 1	Total catch by gear	Total catch in 2022 was 1,741,520t, a 3% increase from 2021 and a 2% decrease from the 2017-2021 average. Purse seine catch in 2022 (1,457,034t) was a 7% increase from 2021 and a 1% increase from the 2017-2021 average. Pole and line catch (135,195t) was a 18% decrease from 2021 and a 14% decrease from the 2017-2021 average catch. Catch by other gears (see Williams and Ruaia (2023) for descriptions) totaled 146,657t; a 2% decrease from 2021 and 19% decrease from the average catch in 2017-2021. In 2022, the percentage of total catch by gear was: purse seine - 84%, other gear - 8%, pole-and-line - 8%, longline - <1%.
Figure 2 - top	Tropical pole and line CPUE	Pole and line CPUE for the Japanese fleet in 2022 (4.88t per day) decreased by 3% from 2021 and decreased by 20% from the 2017-2021 average. Pole and line CPUE for the Solomon Islands fleet in 2022 (2.57t per day) decreased by 4% from 2021 and increased by 27% from the 2017-2021 average.
Figure 2 - bottom	Tropical purse seine CPUE	Free-school CPUE in 2022 (25.4t per day) increased by 10% from 2021 and increased by 5% from the 2017-2021 average. Log-associated CPUE in 2022 (31.84t per day) increased by 115% from 2021 and increased by 28% from the 2017-2021 average. Drifting FAD CPUE in 2022 (35.39t per day) increased by 9% from 2021 and decreased by 3% from the 2017-2021 average. Anchored FAD CPUE in 2022 (15.04t per day) increased by 7% from 2021 and increased by 11% from the 2017-2021 average.
Figure 3	Maps of catch by gear	Compared to the longer time frame, the reduction in pole and line catch in recent years is notable, particularly in the equatorial zone. Three consecutive relatively strong La Niña events shifted catches in 2020-2022 westward from the distribution during the preceding five years; a period that saw a preponderance of El Niño conditions.
Figure 4	Purse seine effort and CPUE maps	Purse seine CPUE has generally been higher in the central and eastern regions of the tropical WCPO, with some notably high catch rates achieved at the margins of this area, particularly towards the WCPFC-CA northeast equatorial region.
Figure 5	Spatial concentration of catch	90% of the purse seine catch in 2022 was taken in 556 1^ox 1^o squares. This was a 11% decrease from 2021 and a 14% decrease from the 2017-2021 average. Over the longer term (25 years), the minimum number of 1^ox 1^o squares in which 90% of the purse seine catch has been taken has slowly, but steadily, increased from a range of 550-600 to a range of 600-650. 90% of the pole and line catch was taken in 277 1^ox 1^o degree squares. This was an 1% decrease from 2021 and an 3% decrease from the 2017-2021 average. After experiencing a sharp contraction between 1980 and 2000 (from 800+ to less than 400 cells), the pole-and-line fishery has been relatively steady over the past 20 years, in terms of how many 1^ox 1^o cells (between 250 and 350) from which 90% of the catch has been taken.
Figure 6	Catch at length by gear type in both numbers and weight	In most years, the catch at length in numbers of fish is broadly bimodal. One peak comprises small fish, generally smaller than 40 cm, taken in the Indonesia/Philippines fisheries; the other peak is comprised of larger fish, generally between 45 and 70 cm, mostly caught in the purse seine fisheries. While numbers of skipjack caught are roughly equal between the two fisheries, catch by weight is dominated by the purse seine fisheries. In 2021 and 2022, the purse seine weight frequency distribution was strongly concentrated between fish of lengths between 40 and 60 cm, more so than previous years over the past decade. This truncated distribution may be due to COVID-related sampling reductions.

Figure	Indicator	Description
Figure 7	Mean weight by gear type	The mean weight of individual fish taken across all gears in 2022 (1.65kg) decreased by 9% from 2021 and decreased by 10% from 2017-2021 average. The mean weight of Indonesia / Philippines domestic caught fish (0.51kg) decreased by 11% from 2021 and increased by 2% from the 2017-2021 average. The mean weight of pole and line caught fish (2.98kg) increased by 47% and increased by 44% from the average in 2017-2021. The mean weight of skipjack from FAD sets (1.65kg) decreased by 16% from 2021 and decreased by 22% from the 2017-2021 average. The mean weight of skipjack from free-school (unassociated) purse seine sets (2.82kg) decreased by 7% from 2021 and decreased by 23% from the 2017-2021 average. Note that mean weight values for 2021 and 2022 are likely biased due to overall low observer coverage with most observer coverage, and therefore size samples, coming from Papua New Guinea and Solomon Islands archipelagic waters and High Seas Pocket 1 catches.
Figure 8	Stochastic stock projections	Under recent fishery conditions, the WCPO skipjack stock is projected to decline slightly, then recover toward the TRP adopted through CMM 2022-01. The projections indicate that median WCPO median $SB_{2024}/SB_{F=0} = 0.48$, and the corresponding risk $SB_{2024}/SB_{F=0} < LRP = 0\%$. With regards to MSY related metrics, median $SB_{2024}/SB_{MSY} = 2.64$ and $F_{2020-2023}/F_{MSY} = 0.34$. The risk that $SB_{2024} < SB_{MSY} = 0\%$ and $F_{2020-2023} > F_{MSY} = 0\%$. Note the Limit Reference Point (LRP) is 20% $SB_{F=0}$ and the TRP value is 50% $SB_{F=0}$.

South Pacific albacore tuna

Figure	Indicator	Description
Figure 9	Total catch by gear	For the southern WCPFC-CA, total albacore catch was 68,957t, a 39% increase from 2021 and a 4% increase from the 2017-2021 average. Longline catch in 2022 (64,916t) increased by 44% from 2021 and increased by 4% from the 2017-2021 average. Catch by other gear (mostly troll catch) (4,027t) decreased by 6% from 2021 and increased by 11% from the 2017-2021 average. In 2022, percentage catch by gear was: longline - 94%, other gear - 6%, pole-and-line - <1%, purse seine - <1%. Note that numbers may differ slightly to those tabulated in the South Pacific albacore trends paper (McKechnie et al., 2023).
Figure 10	Southern longline CPUE (south of 10^oS)	Japanese longline CPUE in 2022 (1.41 fish per 100 hooks) increased by 6% from 2021 and increased by 14% from the 2017-2021 average. Korean longline CPUE (0.62 fish per 100 hooks) increased by 86% from 2021 and increased by 14% from the 2017-2021 average. Chinese longline CPUE (1.68 fish per 100 hooks) increased by 97% from 2021 and increased by 25% from the 2017-2021 average. Finally, Chinese Taipei longline CPUE in 2022 (1.84 fish per 100 hooks) increased by 47% from 2021 and increased by 11% from the 2017-2021 average. The Combined CPUE time series is a weighted average of the other time series; as there is only CPUE data for the Japanese fleet prior to 1963, the Combined CPUE trend is the same as the Japanese CPUE for those years. The 2022 combined mean CPUE value of 5.55 fish per 100 hooks is an increase of 47% from 2021.
Figure 11	Maps of catch by gear	In recent years, catches have concentrated in the 10^oS-20^oS latitudinal band. While 2022 estimates remain provisional, the spatial distribution of the longline catch is similar to the distribution of catches seen over the preceding 5-year period, with the exception of a concentration of catch between 5^oS and 10^oS, centered around 170^oW. The troll catch since 2020 has increased considerably from the previous few years, achieving a level last seen in the early 2000s.
Figure 12	Longline effort and CPUE maps	Over the entire time series, catch rates have been highest south of 10^oS, and the overall pattern is for increasing CPUE as you move from north to south. In the more recent period, catch rates have been highest in the high seas areas between 30^oS and 40^oS. CPUE in the region around southern Melanesia (Vanuatu, New Caledonia, Fiji) shows a decline over time; however 2022 values were notably higher than in 2021.
Figure 13	Spatial concentration of catch	90% of the longline catch in 2022 was taken in 51 5^ox 5^o degree squares of the southern WCPO. This was a 9% decrease from 2021 and a 6% decrease from the 2017-2021 average. The trend over the past decade has been a steady increase in the minimum fished area to capture 90% of the catch, increasing from around 40 to around 55 5^ox 5^o degree squares.
Figure 14	Catch at length by gear type in both numbers and weight	The catch in numbers of fish and weight (t) shows that the largest fish are caught in the longline fisheries and the troll catch is made up of small fish, typically less than 80cm in length. There is little apparent trend in the peak of the length mode from the longline fishery. The recent (3-4 years) increase in the numbers, and total catch weight, of albacore in the 50-70cm size range over the previous three years landed by the 'Other' fishery sector, leveled off in 2021.

Figure	Indicator	Description
Figure 15	Mean weight by gear type	While the mean weight of individual fish taken across all gears is relatively stable over the long-term, 2022 (13.9kg) was a 2% increase from 2021 and a 2% decrease from the 2017-2021 average. The mean weight of longline caught fish (15.21kg) decreased by 1% from 2021 and showed no change from the 2017-2021 average. The mean weight of fish caught in other gears (5.18kg), almost all troll, was a 12% increase from 2021 and increased by 15% from the 2017-2021 average.
Figure 16	Stochastic stock projections	Under recent fishery conditions, the South Pacific albacore stock component within the WCPFC Convention Areas is projected to decline, then recover slightly. The projections indicate that median WCPFC-CA $SB_{2024}/SB_{F=0} = 0.38$, and the corresponding risk that median $SB_{2024}/SB_{F=0} <$ LRP = 21%. Longline vulnerable biomass within the WCPFC-CA is projected to be 51% of the level seen in 2013 + 8% and 72% of that seen on average over 2017-2019. MSY-related metrics are developed at the South Pacific-wide scale. Median $SB_{2024}/SB_{MSY} = 1.50$. $F_{2020-2023}/F_{MSY} = 0.36$. The risk that $SB_{2024} < SB_{MSY} = 13\%$ and $F_{2020-2023} > F_{MSY} = 8\%$. Note the Limit Reference Point (LRP) is 20% $SB_{F=0}$. Note this is a slightly more pessimistic outcome than that reported in the 2022 Indicators paper.

Bigeye tuna

Figure	Indicator	Description
Figure 17	Total catch by gear	Total catch in 2022 was 141,094t, a 1% increase from 2021 and a 4% decrease from the 2017-2021 average. Longline catch in 2022 (54,803t) remained level from 2021 and decreased by 11% from the 2017-2021 average. Purse seine catch in 2022 (63,238t) increased by 1% from 2021 and decreased by 5% from the 2017-2021 average. Pole and line catch (1,880t) decreased by 10% from 2021 and decreased by 20% from the 2017-2021 average. Catch by other gears (see Williams and Ruaia (2023) for descriptions) totaled 21,173t and was an 2% increase from 2021 and 33% increase from the 2017-2021 average. In 2022, percentage catch by gear was: purse seine - 45%, longline - 39%, other gear - 15%, pole-and-line - 1%.
Figure 18 - top	Tropical pole and line CPUE	Japanese pole and line CPUE in 2022 (0.003t per day) decreased by 59% from 2021 and decreased by 74% from the 2017-2021 average. This was the second lowest value on record.
Figure 18 - middle	Tropical purse seine CPUE	Free-school CPUE in 2022 (0.22t per day) decreased by 10% from 2021 and decreased by 28% from the 2017-2021 average. Log-associated CPUE in 2022 (1.87t per day) increased by 33% from 2021 and increased by 14% from the 2017-2021 average. Drifting FAD CPUE in 2022 (3.02t per day) increased by 1% from 2021 and increased by 2% from the 2017-2021 average. Anchored FAD CPUE in 2022 (0.22t per day) increased by 13% from 2021 and decreased by 8% from the 2017-2021 average.
Figure 18 - bottom	Tropical longline CPUE (20°N to 10°S)	Japanese longline CPUE in 2022 (0.49 fish per 100 hooks) increased by 21% from 2021 and increased by 12% from the 2017-2021 average. Korean longline CPUE (0.54 fish per 100 hooks) decreased by 11% from 2021 and decreased by 8% from the 2017-2021 average. US (Hawaiian) longline CPUE (0.21 fish per 100 hooks) decreased by 10% from 2021 and decreased by 29% from the 2017-2021 average.
Figure 19	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 10°N-10°S equatorial band.
Figure 20	Longline effort and CPUE maps	Longline CPUE in the recent period has generally been lower than that seen across the longer time frame. Higher catch rates are now generally limited to the equatorial eastern region of the WCPFC-CA.
Figure 21	Purse seine effort and CPUE maps	While areas of high bigeye catch rates have become more fragmented in recent years, higher catch rates in the tropical eastern region still extend further west in the tropical northern hemisphere (to 10°N) and to the southeast of the tropical region. In the past two years (2021 and 2022), the region between 155°W and 180°, along the equator, has been a purse seine bigeye "hotspot" .
Figure 22	Spatial concentration of catch	90% of the longline catch in 2022 was taken in 102 5°x 5° degree squares of the southern WCPO. This was a 2% increase from 2021 and a 0% decrease from the 2017-2021 average. There has been little or no trend in longline catch concentration over the past 40 years, with around 100 cells accounting for 90% of the catch. 90% of the purse seine catch in 2022 was taken in 540 1°x 1° degree squares of the southern WCPO. This was a 9% decrease from 2021 and a 9% decrease from the 2017-2021 average. The spatial concentration of bigeye purse seine catch has shown little trend since leveling off at around 550 cells in the early 2000s.

Figure	Indicator	Description
Figure 23	Catch at length by gear type in both numbers and weight	The catch in numbers of fish was predominantly made up of small fish (<50cm) in the most recent years from the Indonesia/Philippines fisheries. Larger fish (>100cm), as well as the majority of the total catch, are generally caught in the longline fisheries. Intermediate sized fish (40cm-80cm) are taken in the purse seine fisheries. More bigeye <70cm were taken in FAD sets in 2021 and 2022 than has been the case in the past several years. Note that this may be due to overall low observer coverage with most observer coverage, and therefore size samples, coming from Papua New Guinea and Solomon Islands archipelagic waters and High Seas Pocket 1 catches.
Figure 24	Mean weight by gear type	The mean weight of individual fish taken across all gears in 2022 (3.59kg) increased by 3% from 2021 and decreased by 18% from the 2017-2021 average. The mean weight of longline caught fish (44.04kg) decreased by 5% from 2021 and increased by 3% from the 2017-2021 average. The mean weight of Indonesia / Philippines domestic caught fish (0.97kg) increased by 14% from 2021 and increased by 21% from the 2017-2021 average. The mean weight of free-school caught purse seine fish (6.83kg) decreased by 16% from 2021 and decreased by 35% from the 2017-2021 average. The mean weight of FAD caught fish (3.68kg) decreased by 8% from 2021 and decreased by 30% from the 2017-2021 average.
NA	Stochastic stock projections	NA - as a new assessment has been undertaken in 2023, and final grid still to be selected by SC, no projection is presented for bigeye here, however Day et al. (2023) will aim to present some preliminary projections based on the new assessment.

Yellowfin tuna

Figure	Indicator	Description
Figure 25	Total catch by gear	Total catch in 2022 was 713,858t, a 5% decrease from 2021 and a 1% decrease from the 2017-2021 average. Purse seine catch in 2022 (372,404t) decreased by 8% from 2021 and decreased by 8% from the 2017-2021 average. Longline catch in 2022 (84,232t) increased by 11% from 2021 and decreased by 4% from the 2017-2021 average. Pole and line catch (20,506t) decreased by 2% from 2021 and decreased by 15% from the 2017-2021 average. Catch by other gear (see Williams and Ruaia (2023) for descriptions) totaled 236,716t and was a 7% decrease from 2021 and a 18% increase from the average catch in 2017-2021. This is mainly due to the large fluctuations in estimates for the other gears in Indonesia in recent years. In 2022, percentage catch by gear was: purse seine - 52%, longline - 12%, other gear - 33%, pole-and-line - 3%.
Figure 26 - top	Tropical pole and line CPUE	Japanese pole and line CPUE in 2022 (0.031t per day) decreased by 83% from 2021 and decreased by 61% from the 2017-2021 average. At the time of writing this report the Solomon Islands CPUE is too variable to be informative, probably due to the small size of the fishery.
Figure 26 - middle	Tropical purse seine CPUE	Free-school CPUE in 2022 (7.36t per day) was a 12% decrease and decreased by 6% from the 2017-2021 average. Log-associated CPUE in 2022 (13.38t per day) increased by 84% from 2021 and increased by 70% from the 2017-2021 average. The 2022 value was the highest on record. Drifting FAD CPUE in 2022 (7.27t per day) increased by 4% from 2021 and increased by 11% from the 2017-2021 average. Anchored FAD CPUE in 2022 (6.66t per day) decreased by 37% from 2021 and decreased by 35% from the 2017-2021 average.
Figure 26 - bottom	Tropical longline CPUE (20^{o}N to 10^{o}S)	Japanese longline CPUE in 2022 (1.5 fish per 100 hooks) increased by 53% from 2021 and increased by 75% from the 2017-2021 average. The 2022 value was the highest in nearly 40 years. Korean longline CPUE (0.72 fish per 100 hooks) increased by 6% from 2021 and increased by 3% from the 2017-2021 average.
Figure 27	Maps of catch by gear	Compared to the longer time frame, a slightly higher proportion of the catch in recent years has been taken by the purse seine fishery within the 10^{o}N-10^{o}S equatorial band, with catches higher in the mid-tropical WCPO band, mirroring skipjack. Catch in the Indonesian/Philippines region remains notably high.
Figure 28	Longline effort and CPUE maps	Longline CPUE in the recent period has generally been lower than that seen across the longer time frame. Relatively high catch rates are now found only in the tropical western region of the WCPFC-CA. Over the last five years, there was a strong contraction in the high CPUE area compared to the long-term, however a relatively high CPUE area in the region of the Kiribati Line Islands was present in 2021.
Figure 29	Purse seine effort and CPUE maps	Areas of high CPUE have fragmented over time, across the tropical WCPFC-CA, and were concentrated in the west of the tropical region in 2022, with some localised high CPUE achieved in other areas, in around the high seas pocket region between Tuvalu and Kiribati.
Figure 30	Spatial concentration of catch	90% of the longline catch in 2022 was taken in 82 5^{o}x 5^o degree squares of the southern WCPO. This was a 16% decrease from 2021 and a 15% decrease from the 2017-2021 average. 90% of the purse seine catch in 2022 was taken in 445 1^{o}x 1^o degree squares of the southern WCPO. This was an 4% decrease from 2021 and a 12% decrease from the 2017-2021 average.

Figure	Indicator	Description
Figure 31	Catch at length by gear type in both numbers and weight	The catch in numbers of fish was predominantly made up of small fish (<50cm) from the Indonesia/Philippines fisheries. Large fish (>90cm) are mostly caught in the longline and unassociated purse seine fisheries and larger yellowfin dominate the catch by weight, in contrast to catch in number. In both 2021 and 2022, the total number of yellowfin taken in the Indonesia/Philippines fisheries was down from the high numbers seen in the 2018-2020 catches, and a sizable increase in PS-associated catch of 40-60 cm yellowfin is noted.
Figure 32	Mean weight by gear type	The mean weight of individual fish taken across all gears in 2022 (2.2kg) increased by 3% from 2021 and decreased by 11% from the 2017-2021 average. The mean weight of longline caught fish (31.7kg) increased by 4% from 2021 and increased by 10% from the 2017-2021 average. The mean weight of Indonesia / Philippines domestic caught fish (1.01kg) decreased by 6% from 2021 and increased by 11% from the 2017-2021 average. The mean weight of free-school caught purse seine fish (10.28kg) increased by 19% from 2021 and decreased by 28% from the 2017-2021 average. The mean weight of FAD caught fish (2.84kg) increased by 10% from 2021 and decreased by 26% from the 2017-2021 average.
NA	Stochastic stock projections	NA - as a new assessment has been undertaken in 2023, and final grid still to be selected by SC, no projection is presented for yellowfin here, however Magnusson et al. (2023) will aim to present some preliminary projections based on the new assessment.

5 Figures

Skipjack

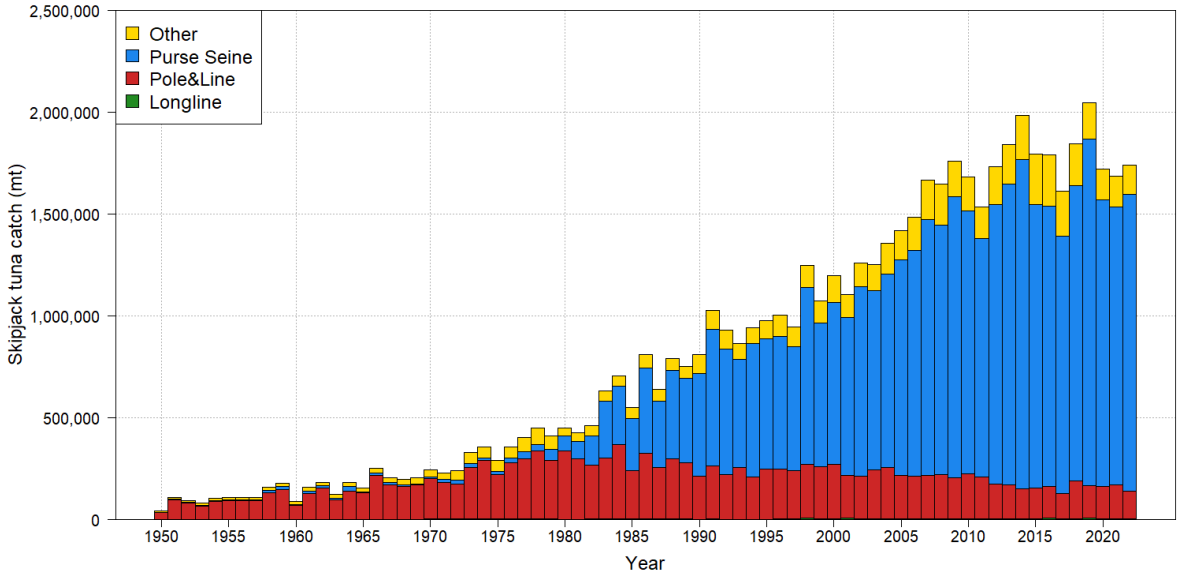

Figure 1: Skipjack tuna catch (mt) by gear type and year for the WCPFC-Convention Area.

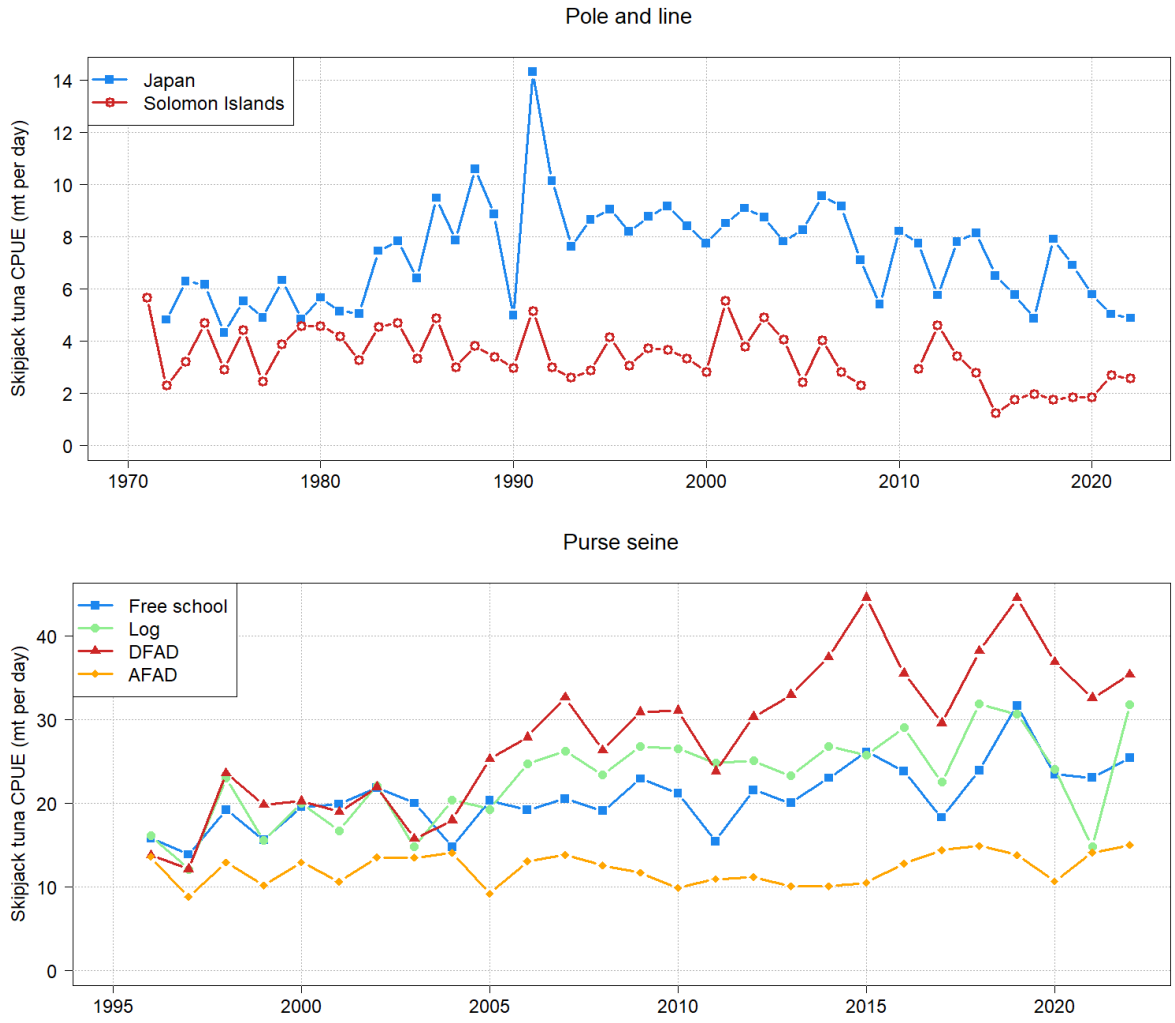

Figure 2: Skipjack tuna catch per unit effort in the tropical WCPO by year for major pole and line fishing fleets (top), and purse seine (all fleets combined) for the major set types (bottom). Note different time series lengths.

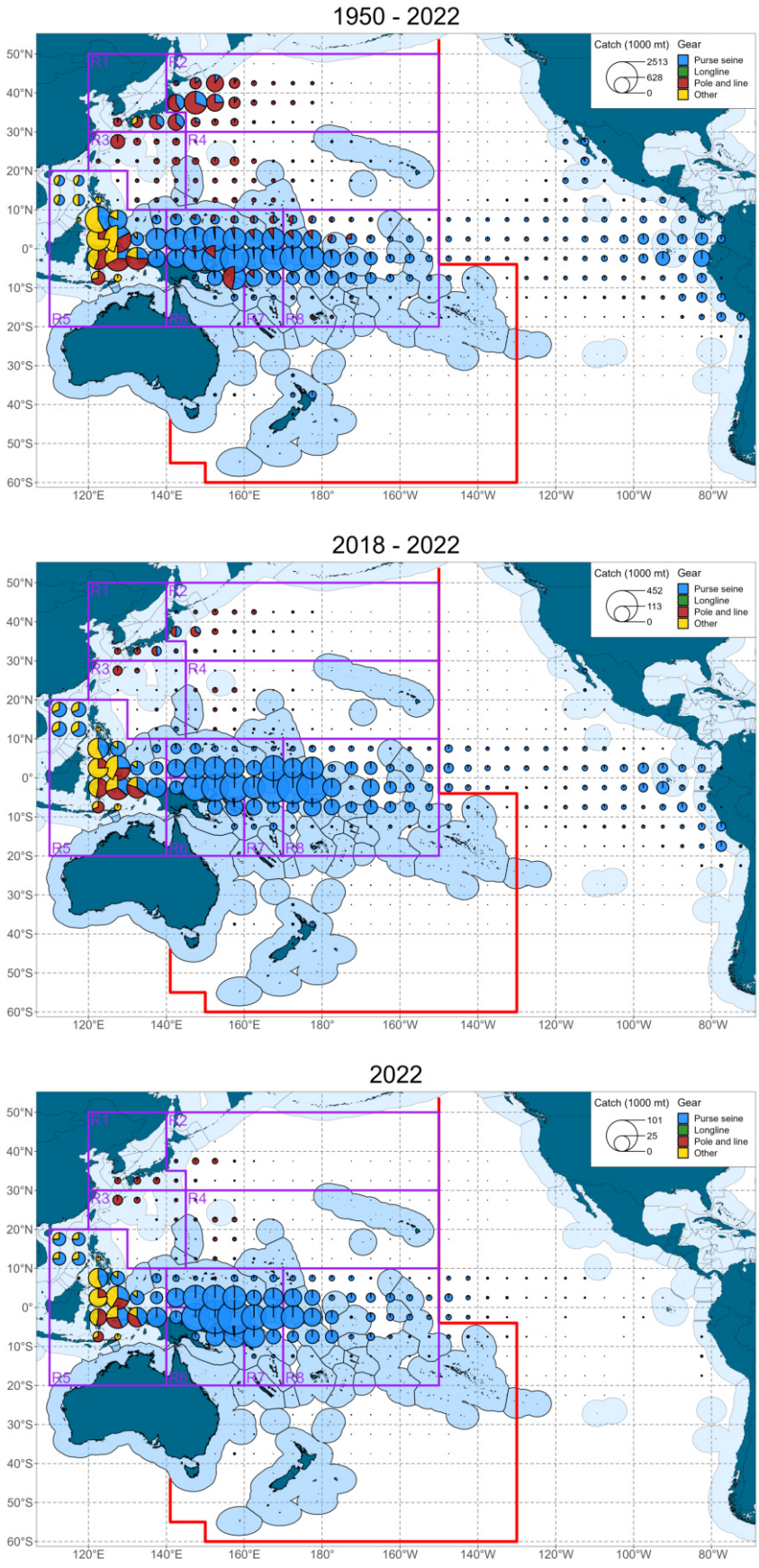

Figure 3: Skipjack tuna catch distribution by gear type and 5^{o}x 5^o region for the Pacific Ocean for the period 1950-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note that the scale differs between panels and the figure legends provide the catch associated with each maximum circle size. The skipjack assessment regions are outlined in purple, the WCPFC-CA is outlined in red. Catch data for the EPO in 2022 are incomplete.

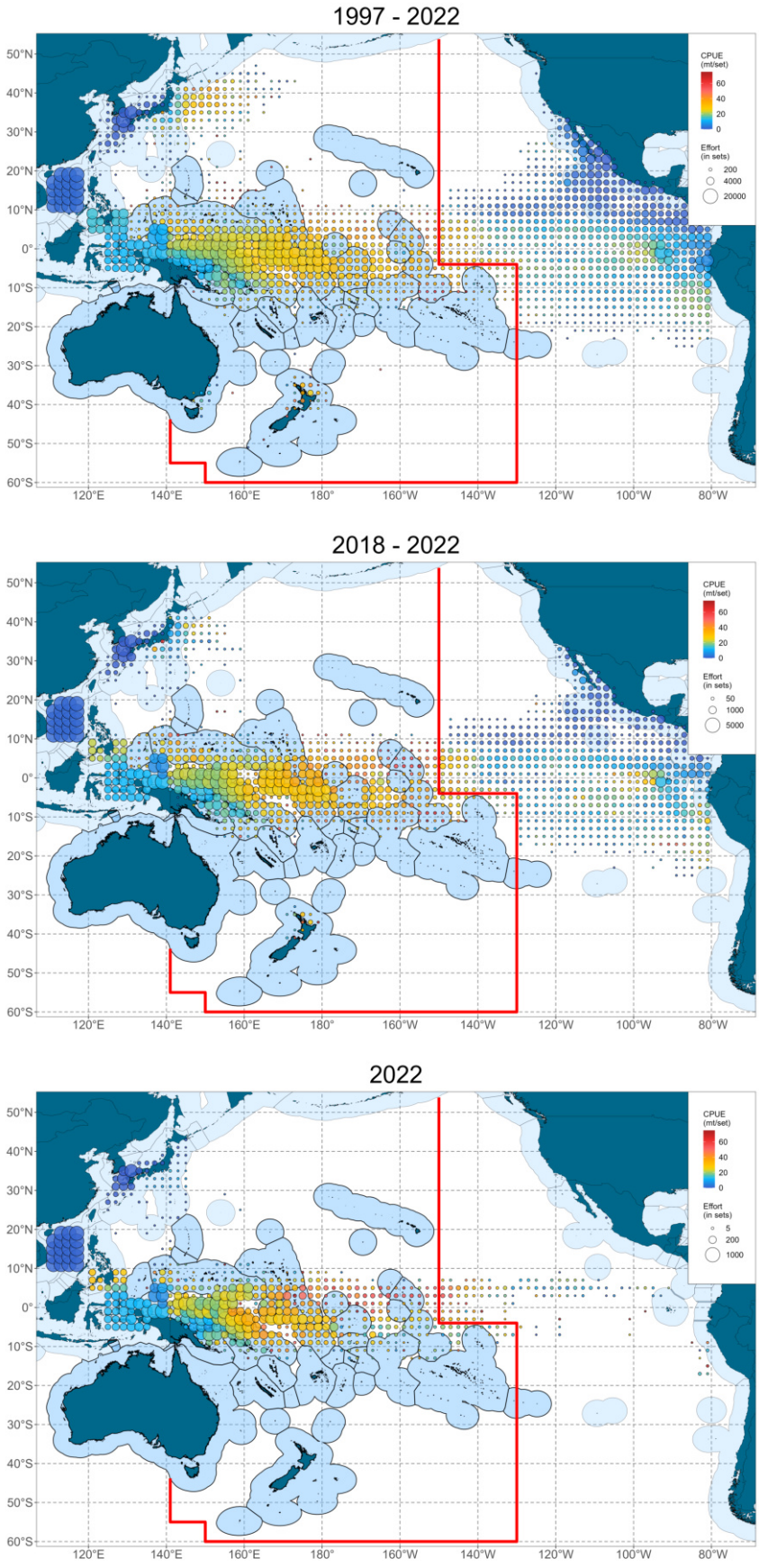

Figure 4: Distribution of 2^ox 2^o purse seine effort (represented by circle size) and skipjack tuna CPUE (represented by colour) for the period 1950-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note the differences in scales between plots. The WCPFC-CA is outlined in red. CPUE data for the EPO in 2022 are incomplete.

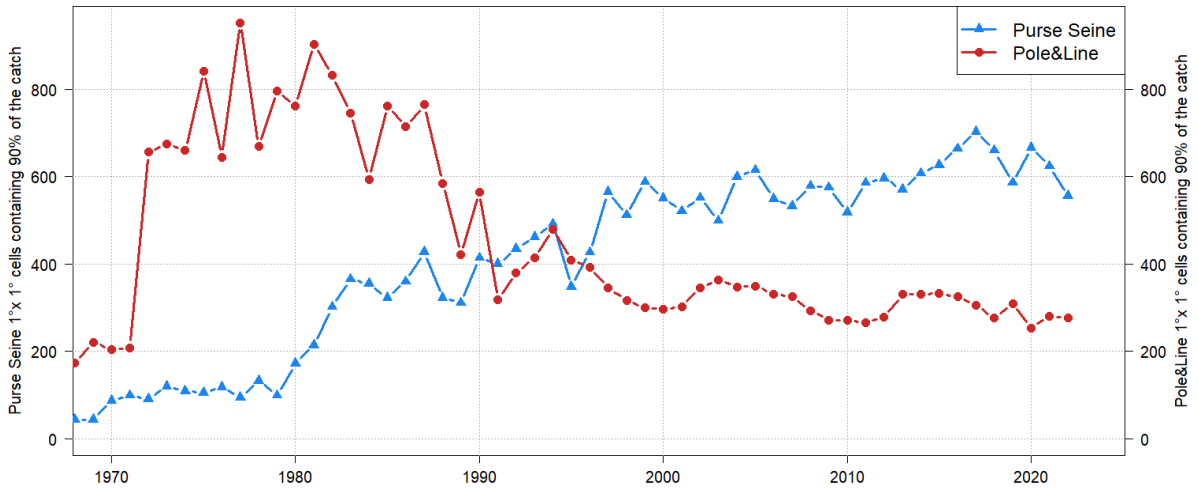

Figure 5: Spatial concentration of skipjack tuna catch for purse seine and pole and line fisheries by year for the WCPO.

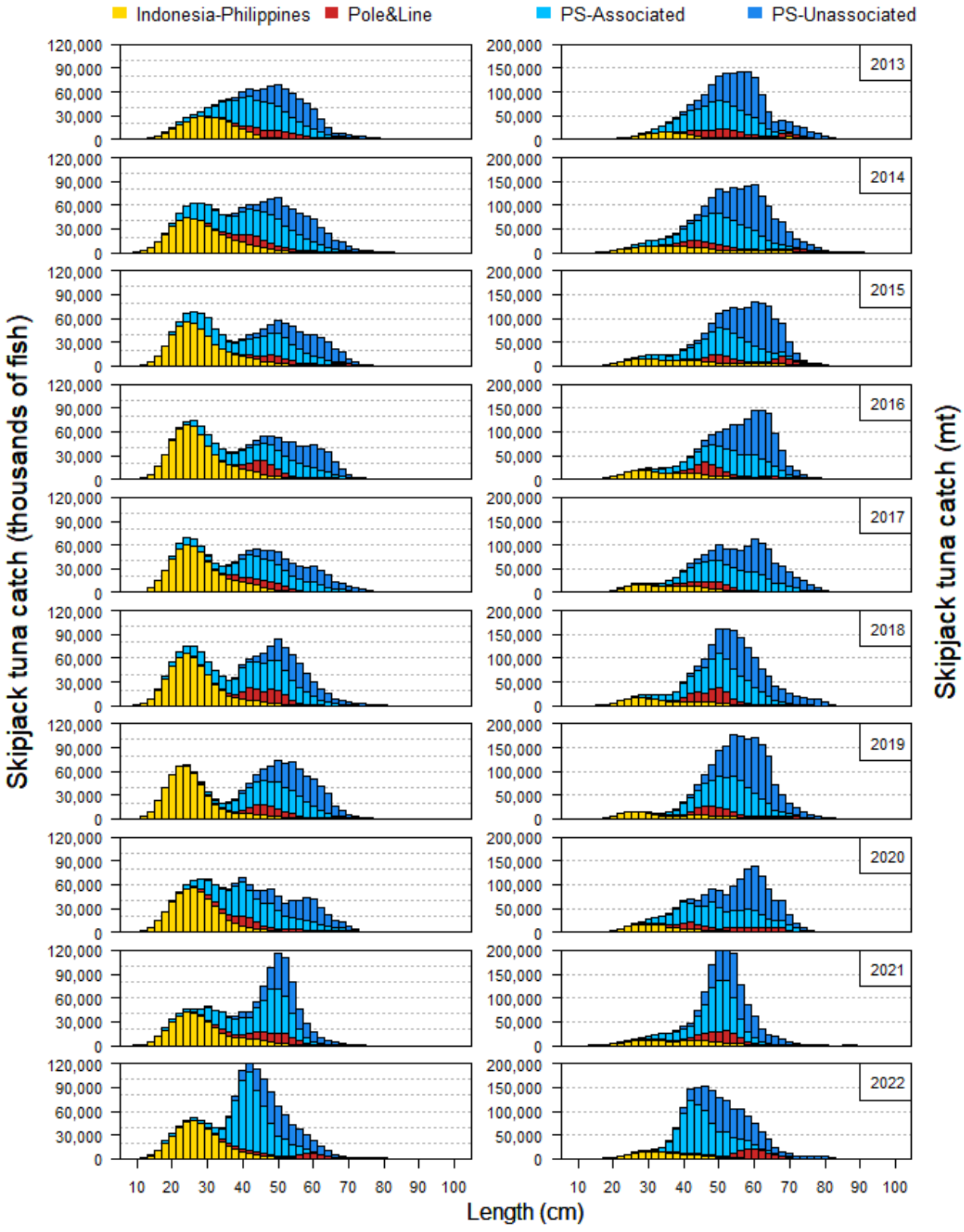

Figure 6: Catch-at-size of skipjack tuna by gear type and year for the WCPO. Catch is provided in thousands of fish (left) and metric tonnes (right).

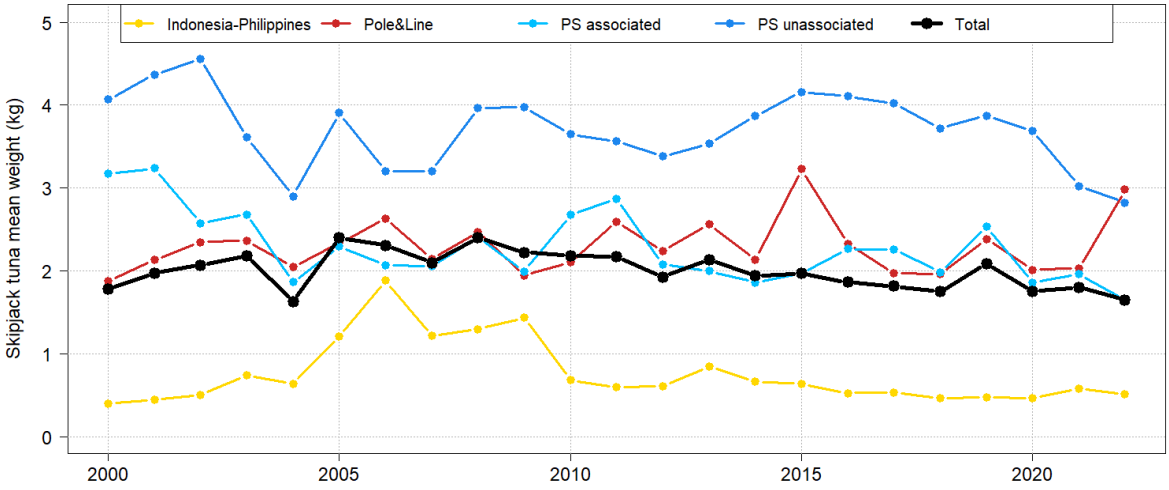

Figure 7: Mean weight of individual skipjack tuna taken by gear and year for the WCPO. The 'total' line represents the mean skipjack weight for the total catch.

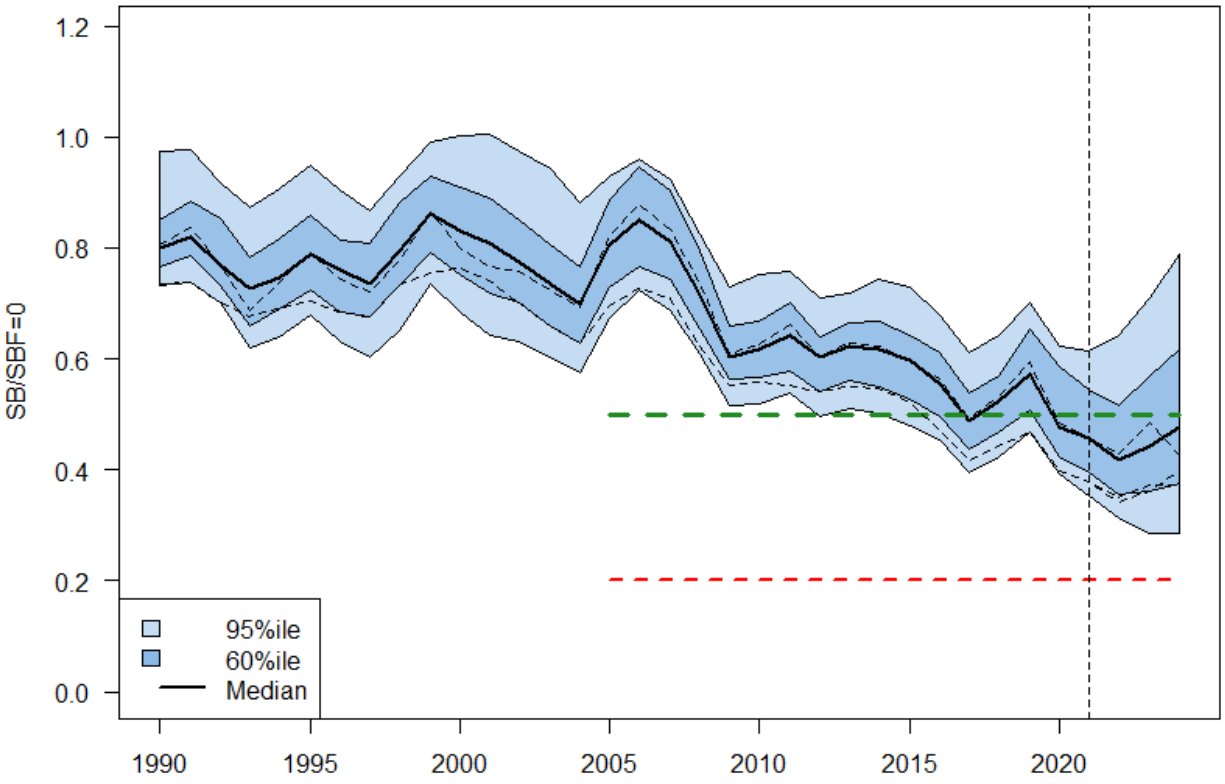

Figure 8: Skipjack spawning biomass depletion ($SB/SB_{F=0}$) from the uncertainty grid of assessment model runs for the period 1990 to 2021 (the vertical line at 2021 represents the last year of the assessment), and stochastic projection results for the period 2022 to 2024 assuming actual catch and effort levels in 2022, and that 2022 fishing levels continued until 2024. Prior to 2022 the data represent the 60th and 95th percentiles of the uncertainty grid from the assessment models and the median. During the projection period (2022-2024) levels of recruitment variability estimated over the period used to estimate the stock-recruitment relationship (1982-2021) are assumed to continue in the future. Projections are from the model runs of Castillo-Jordan et al., 2022. The dashed lines indicate three example trajectories (chosen randomly out of 1800) from the model grid. The red dashed line represents the WCPFC agreed limit reference point (0.20), the green line the WCPFC target reference point adopted through CMM 2022-01 (0.50).

South Pacific albacore

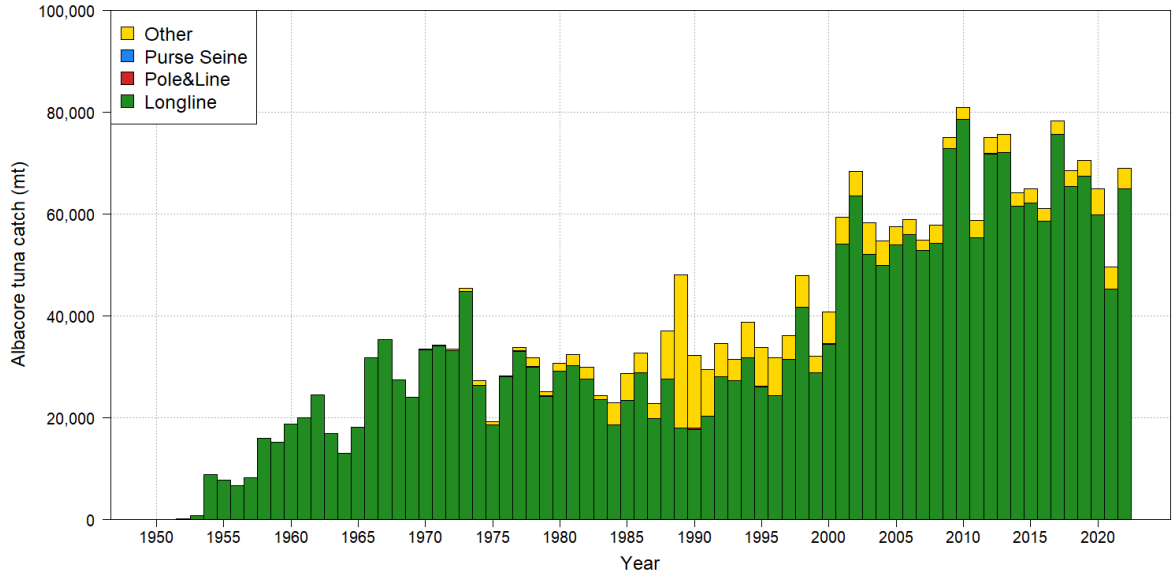

Figure 9: South Pacific albacore tuna catch (mt) by gear type and year for the WCPFC-Convention Area south of the equator. Note: 'Other' gear here is primarily troll gear, but includes driftnet catches in the 1980s and early 1990s.

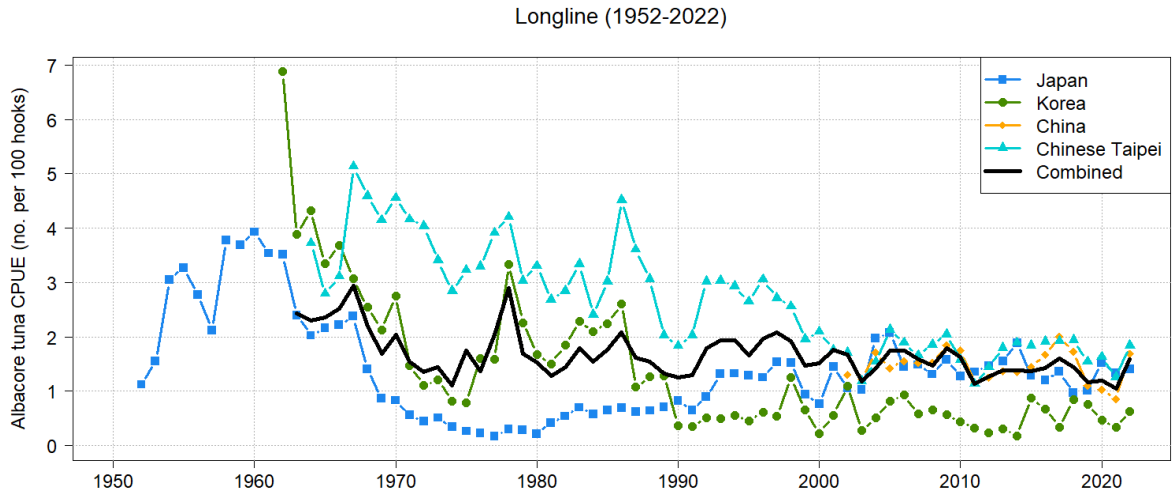

Figure 10: South Pacific albacore tuna catch per unit effort in the southern WCPFC-CA (south of 10^{o}S) by year for major longline fleets.

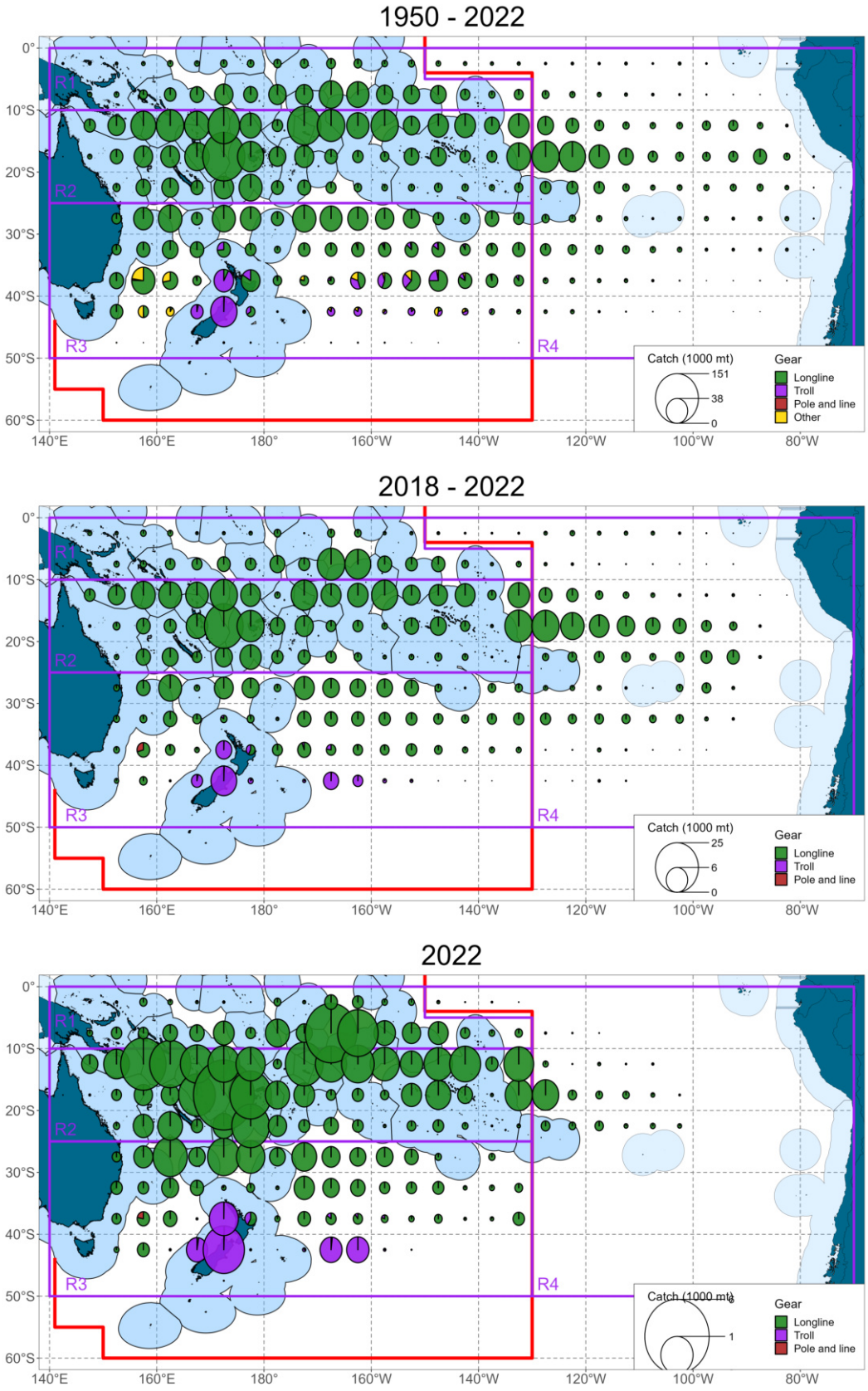

Figure 11: South Pacific albacore tuna catch distribution by gear type and 5^{o}x 5^o region for the Pacific Ocean for the period 1950-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note that the scale differs between panels and the figure legends provide the catch associated with each maximum circle size. The albacore assessment regions are outlined in purple, the WCPFC-CA is outlined in red. Catch data for the EPO in 2022 are incomplete.

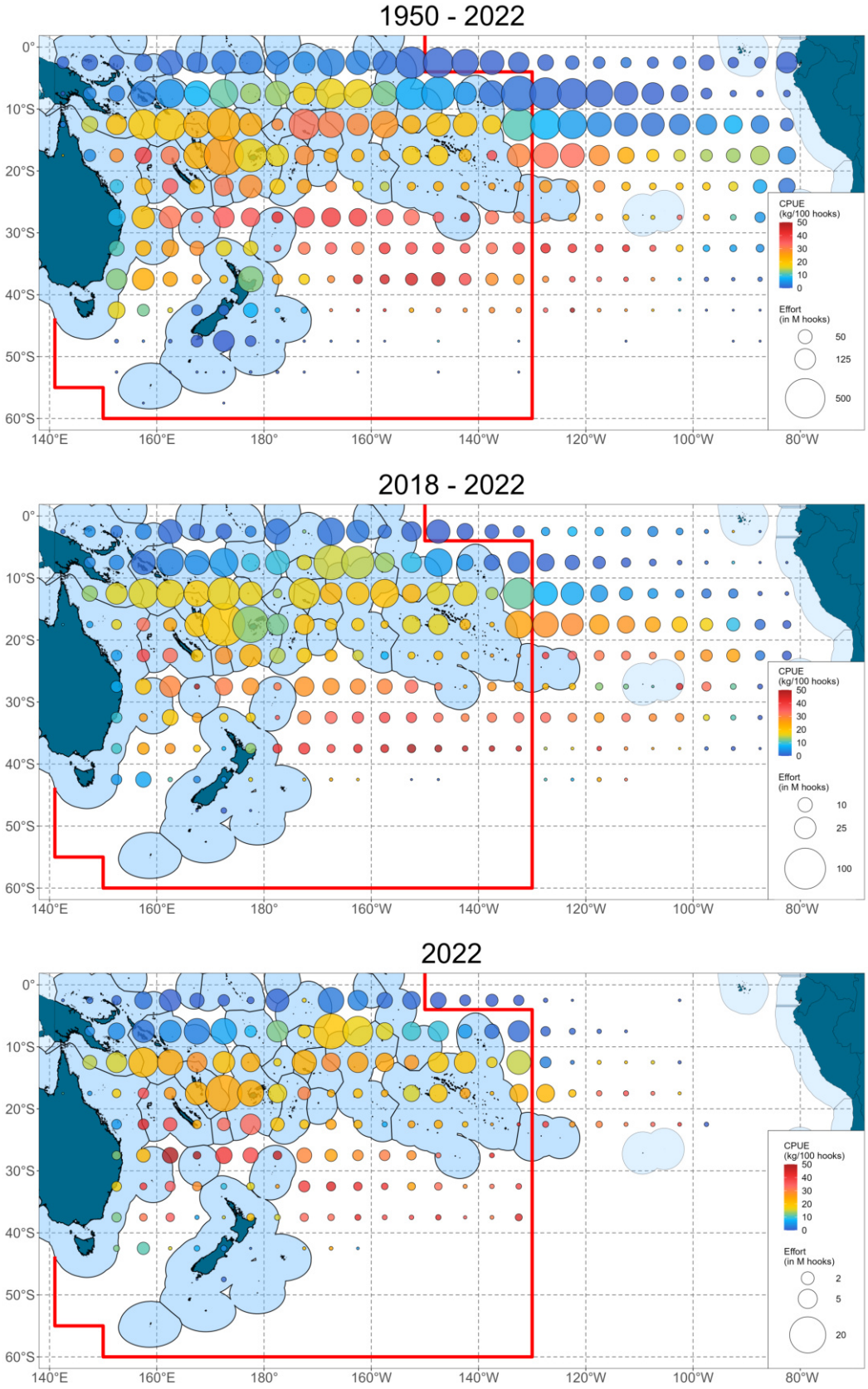

Figure 12: Distribution of 5°x 5° longline effort (represented by circle size) and South Pacific albacore tuna CPUE (represented by colour) for the period 1950-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note the differences in scales between plots. The WCPFC-CA is outlined in red. Catch data for the EPO in 2022 are incomplete.

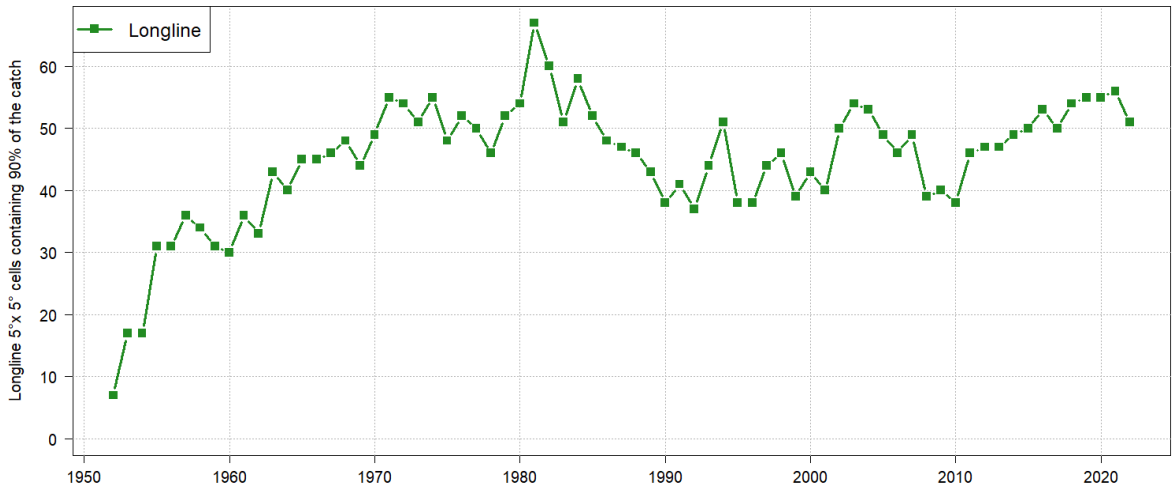

Figure 13: Spatial concentration of South Pacific albacore tuna catch for the longline fishery by year for the WCPO.

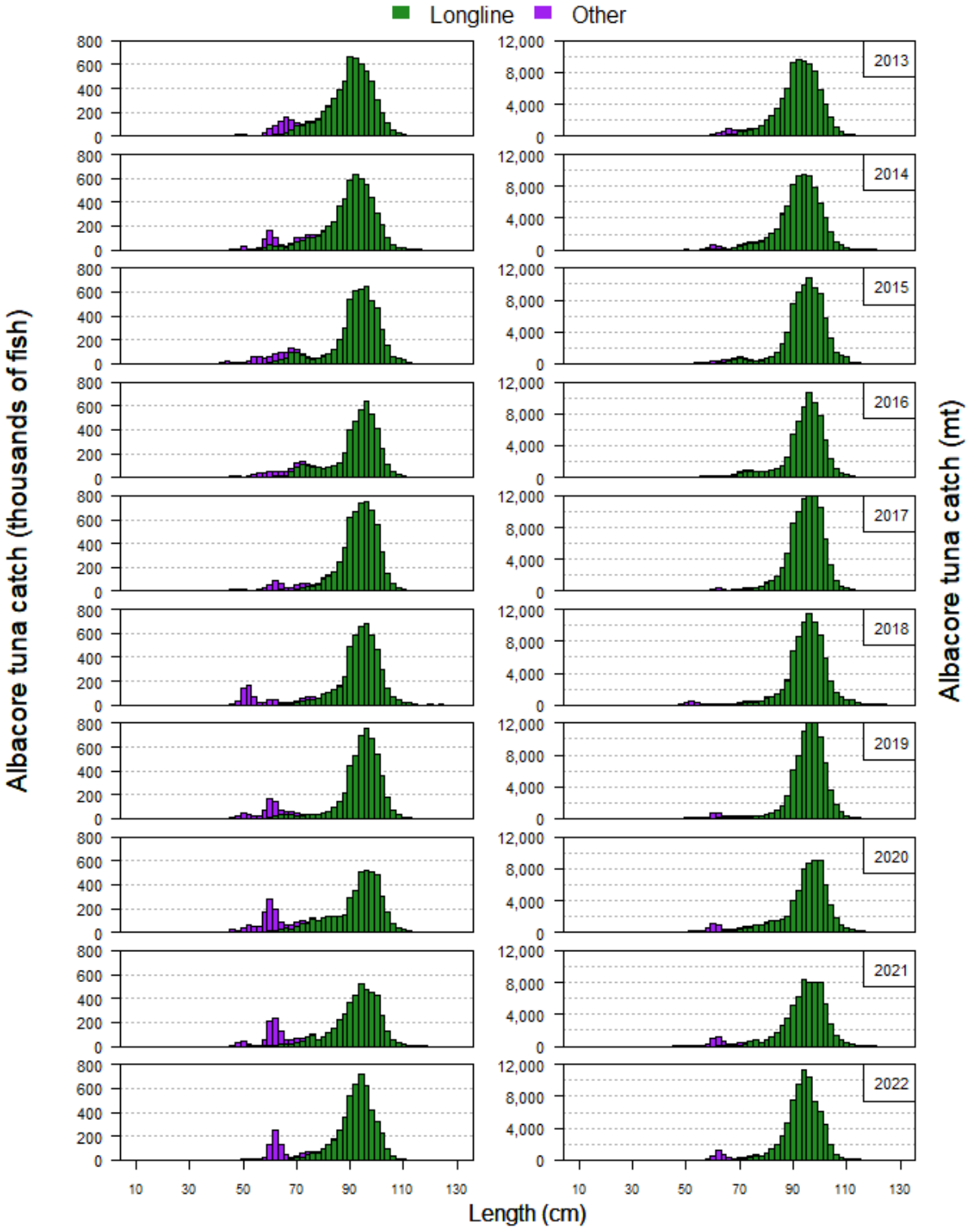

Figure 14: Catch-at-size of South Pacific albacore tuna by gear type and year for the WCPO. Catch is provided in thousands of fish (left) and metric tonnes (right). "Other" gear is almost entirely troll caught albacore.

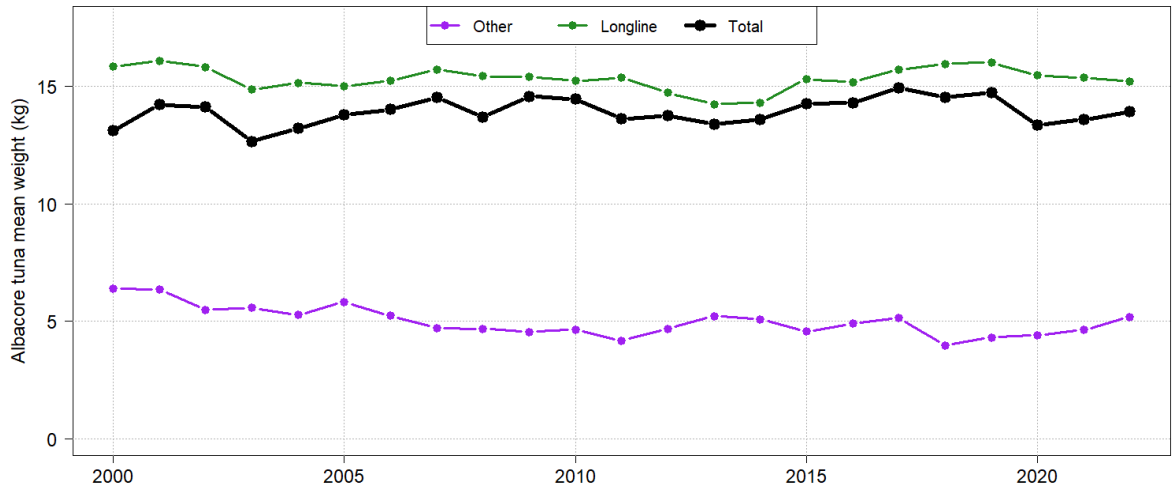

Figure 15: Mean weight of individual South Pacific albacore tuna taken by gear and year for the WCPO. The 'total' line represents the mean albacore weight for the total catch.

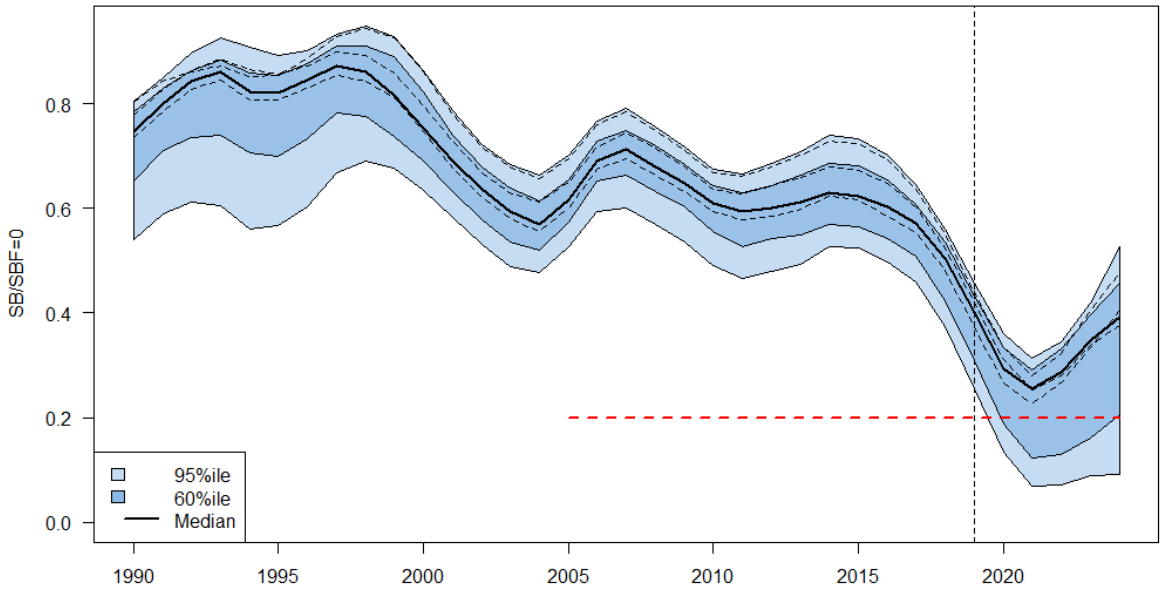

Figure 16: Stochastic projection results of South Paciific albacore tuna spawning biomass ($SB/SB_{F=0}$) from 2019 using actual catch and effort levels between 2020 and 2022 and then through to 2024 assuming 2022 levels continued. Prior to 2020 the data represent the 60th and 95th percentiles of the uncertainty grid from the assessment models and the median. Levels of recruitment variability estimated for the period used to estimate the stock-recruitment relationship (1960-2017) are assumed to continue in the future. Projections are from the model runs of Castillo-Jordan et al., 2021, and are projected on the basis of albacore catch. The dashed lines indicate three example trajectories (chosen randomly out of 7200) from the model grid. The red dashed line represents the WCPFC agreed limit reference point (0.20).

Bigeye

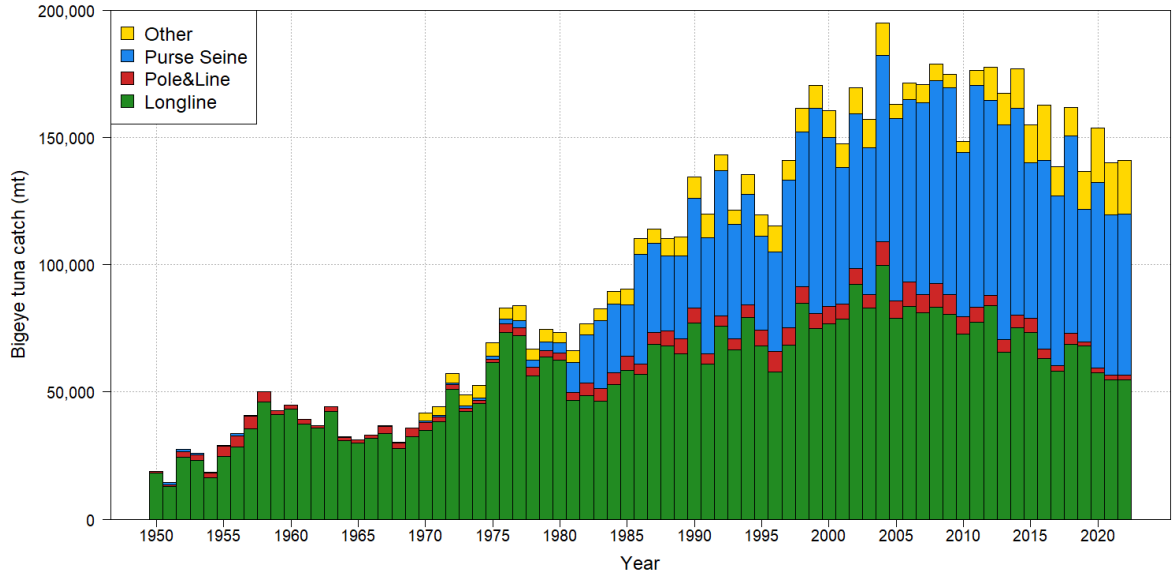

Figure 17: Bigeye tuna catch by gear type and year for the WCPFC-Convention Area.

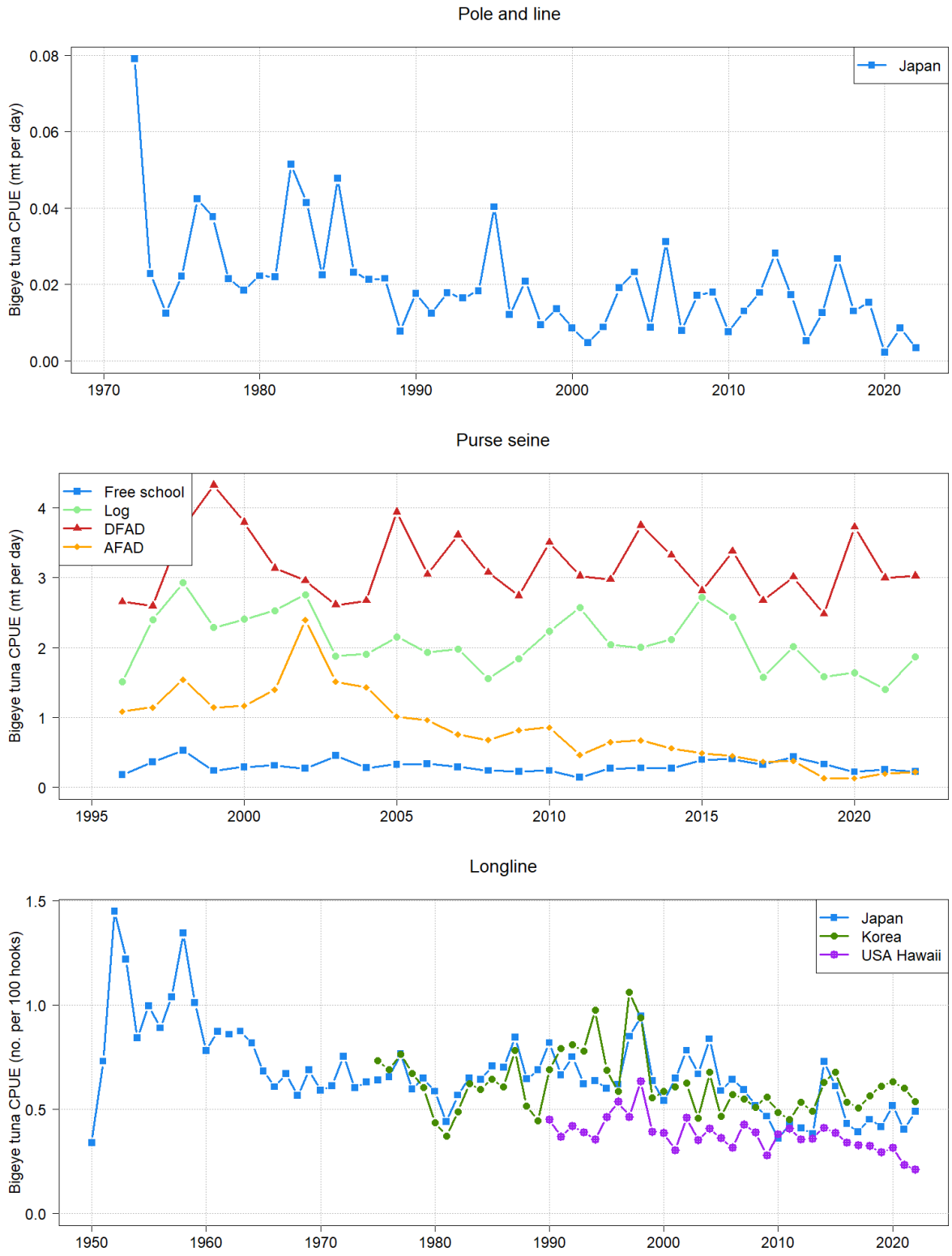

Figure 18: Bigeye tuna catch per unit effort in the tropical WCPO by year for major pole and line fishing fleets (top), purse seine for the major set types (middle), and tropical longline for three fleets (bottom; 20^{o}N to 10^{o}S, WCPFC-CA). Note different time series lengths.

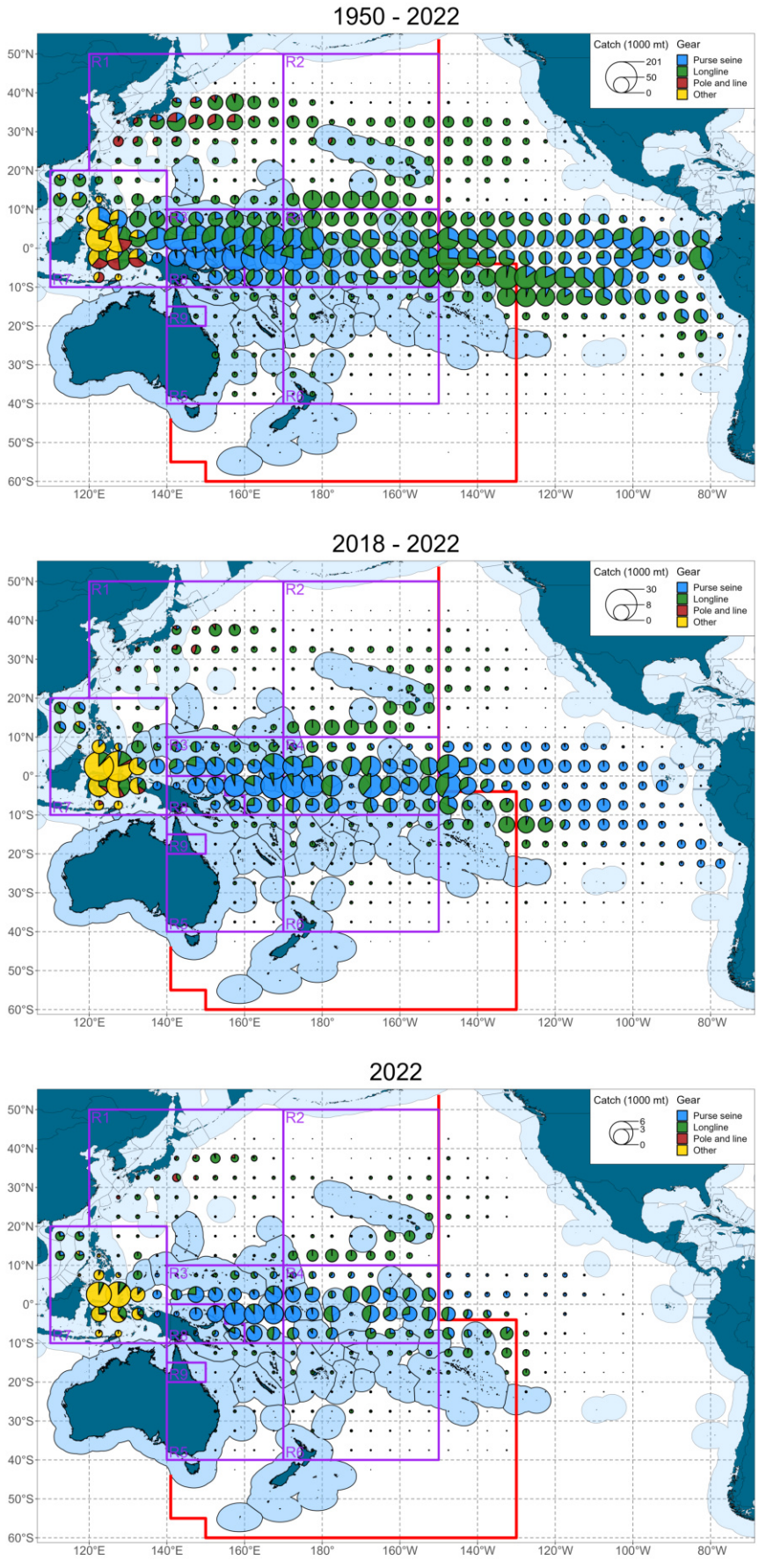

Figure 19: Bigeye tuna catch distribution by gear type and 5^ox 5^o region for the Pacific Ocean for the period 1950-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note that the scale differs between panels and the figure legends provide the catch associated with each maximum circle size. The bigeye assessment regions are outlined in purple, the WCPFC-CA is outlined in red. Catch data for the EPO in 2022 are incomplete.

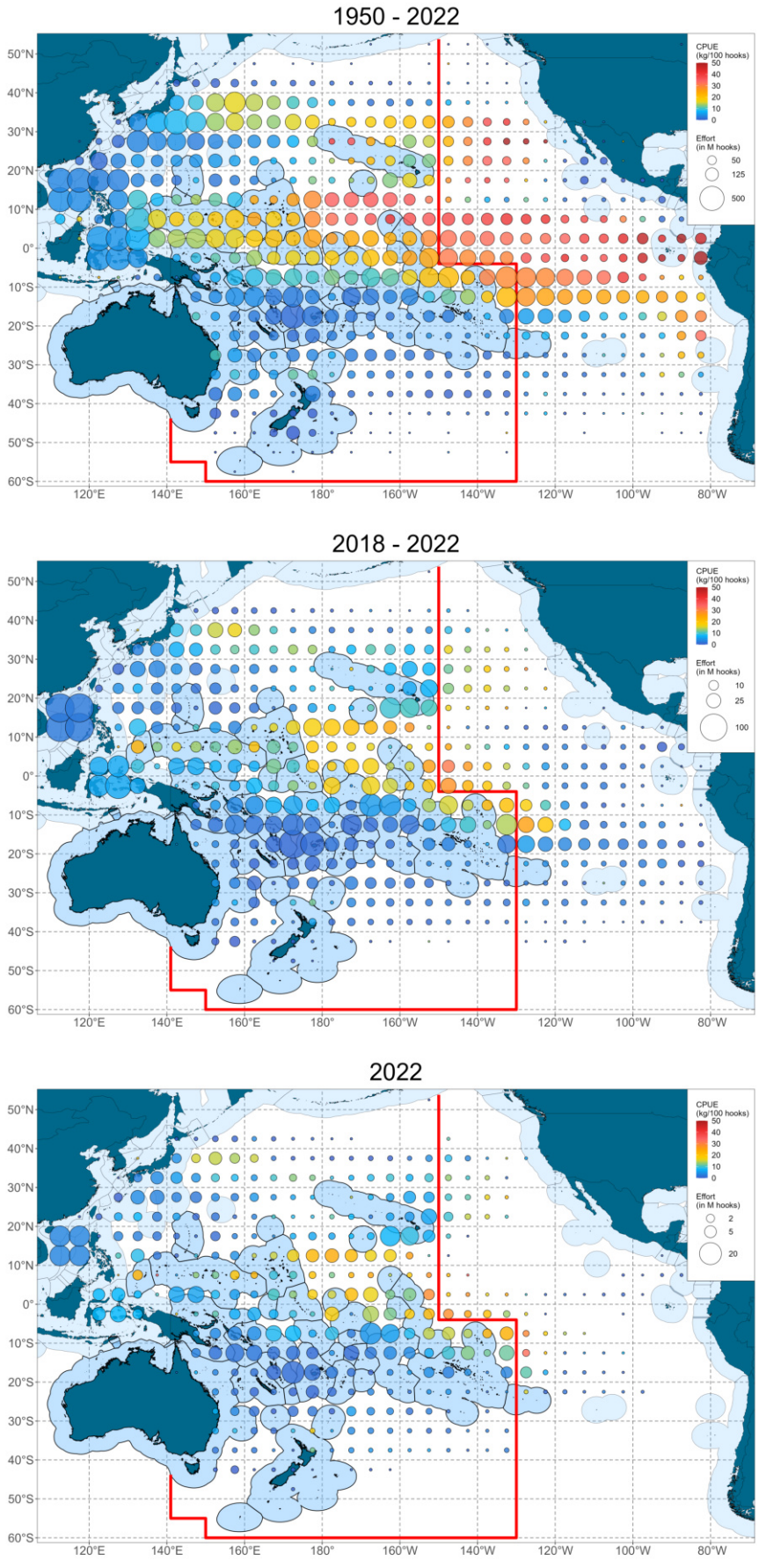

Figure 20: Distribution of 5^{o}x 5^o longline effort (represented by circle size) and bigeye tuna CPUE (represented by colour) for the period 1950-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note the differences in scales between plots. The WCPFC-CA is outlined in red. Catch data for the EPO in 2021 are incomplete.

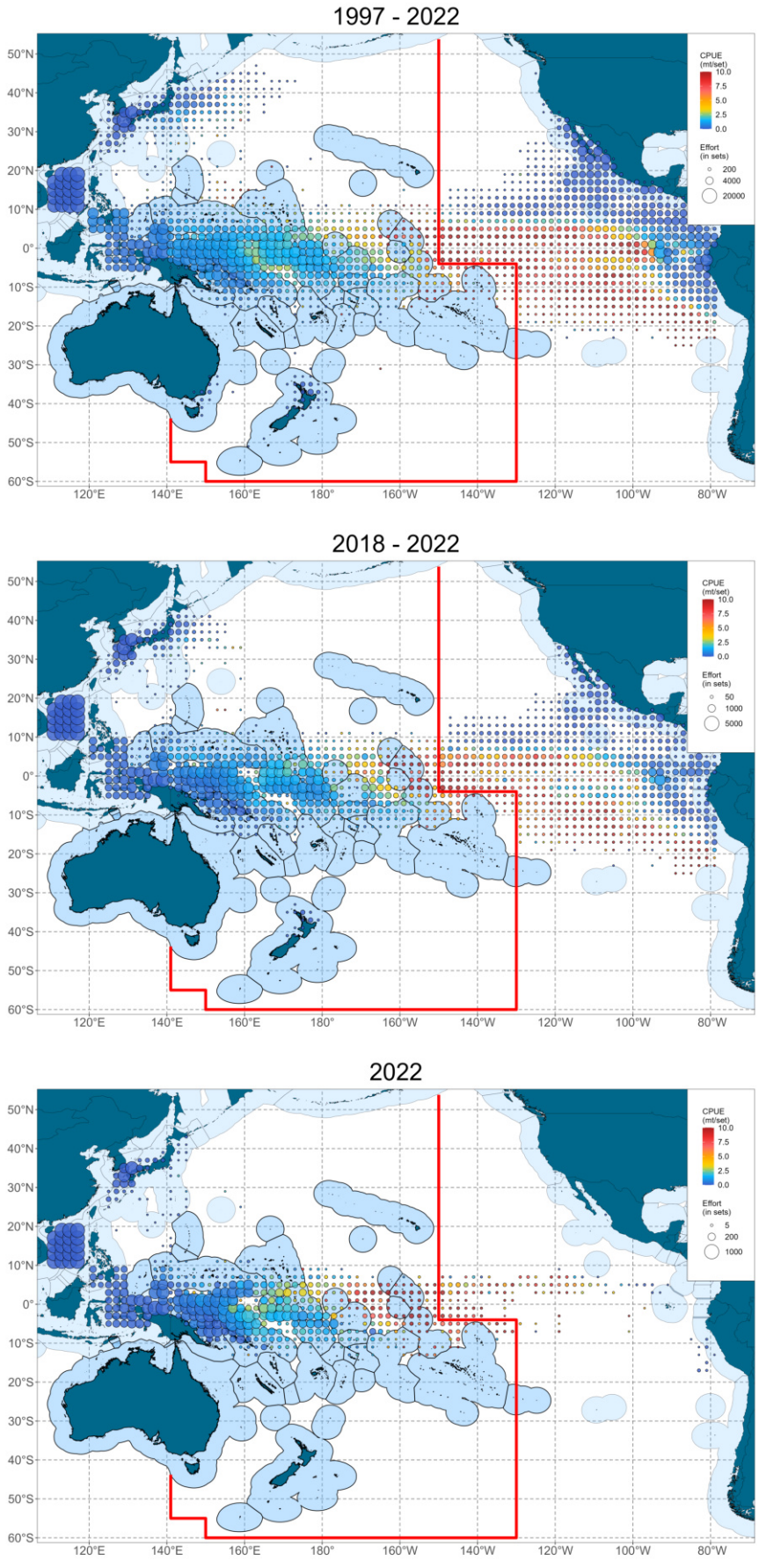

Figure 21: Distribution of 2°x 2° purse seine effort (represented by circle size) and bigeye tuna CPUE (represented by colour) for the period 1997-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note the differences in circle size scale between plots. The WCPFC-CA is outlined in red. Catch data for the EPO in 2022 are incomplete.

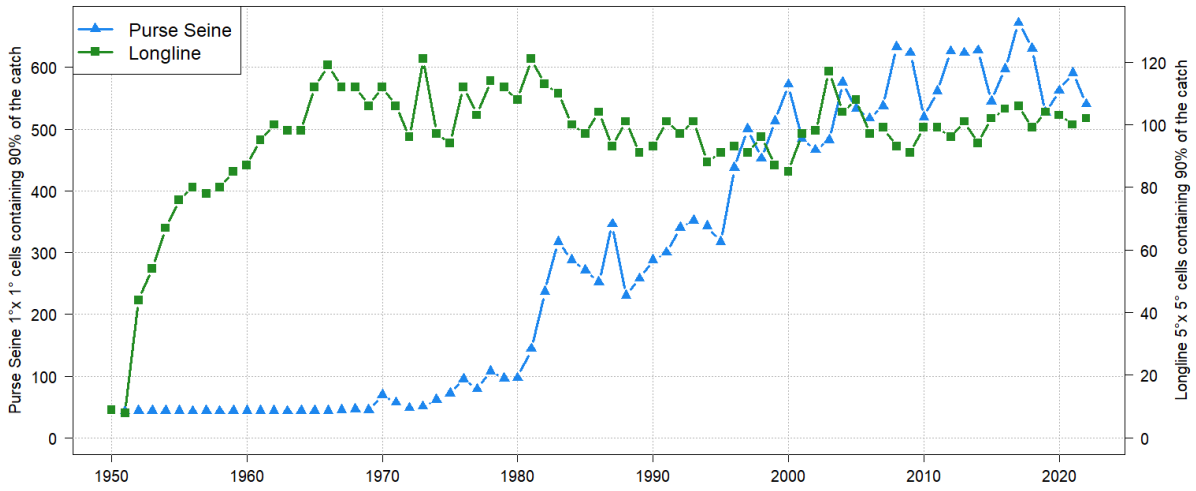

Figure 22: Spatial concentration of bigeye tuna catch for purse seine and longline by year for the WCPO.

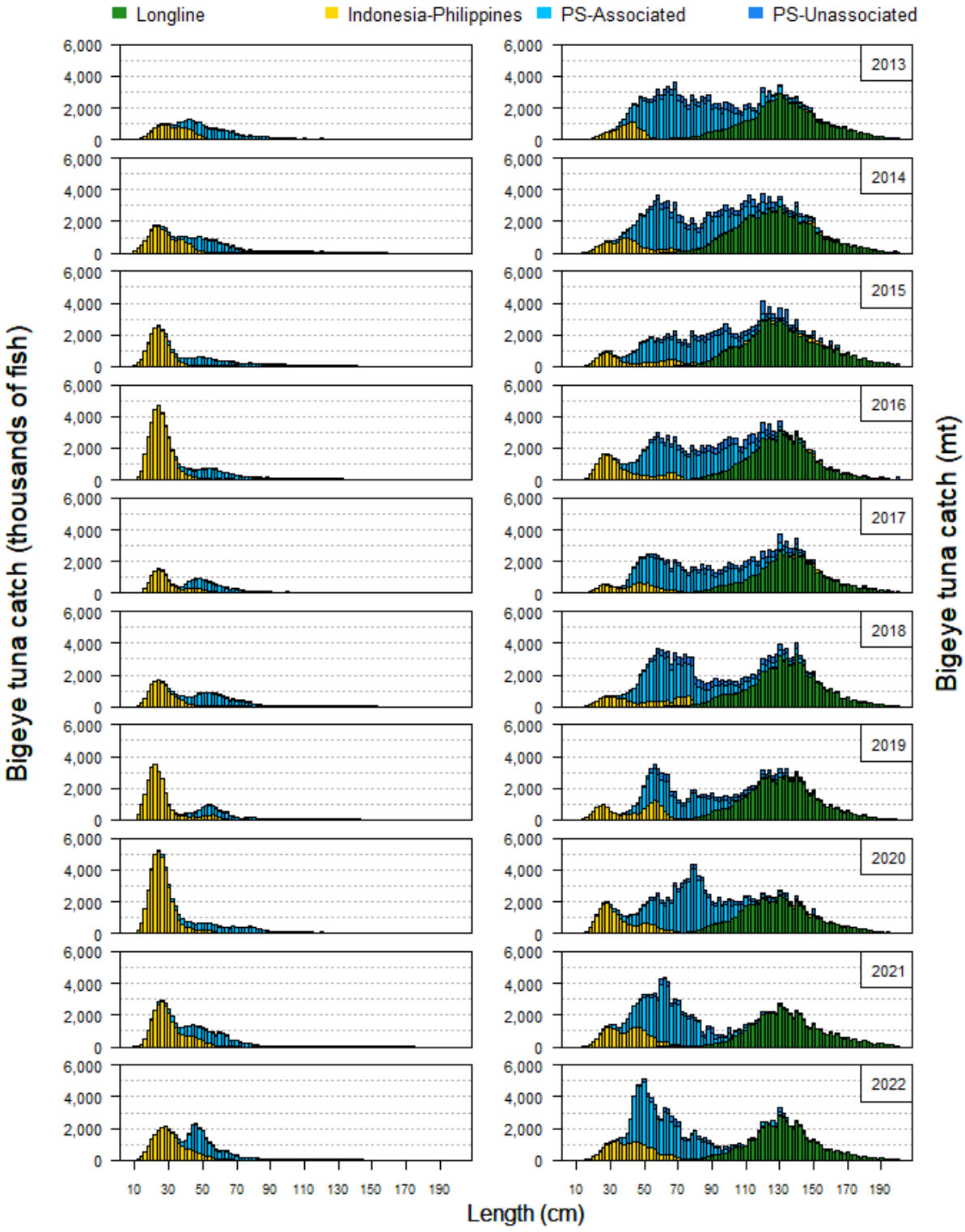

Figure 23: Catch-at-size of bigeye tuna by gear type and year for the WCPO. Catch is provided in thousands of fish (left) and metric tonnes (right).

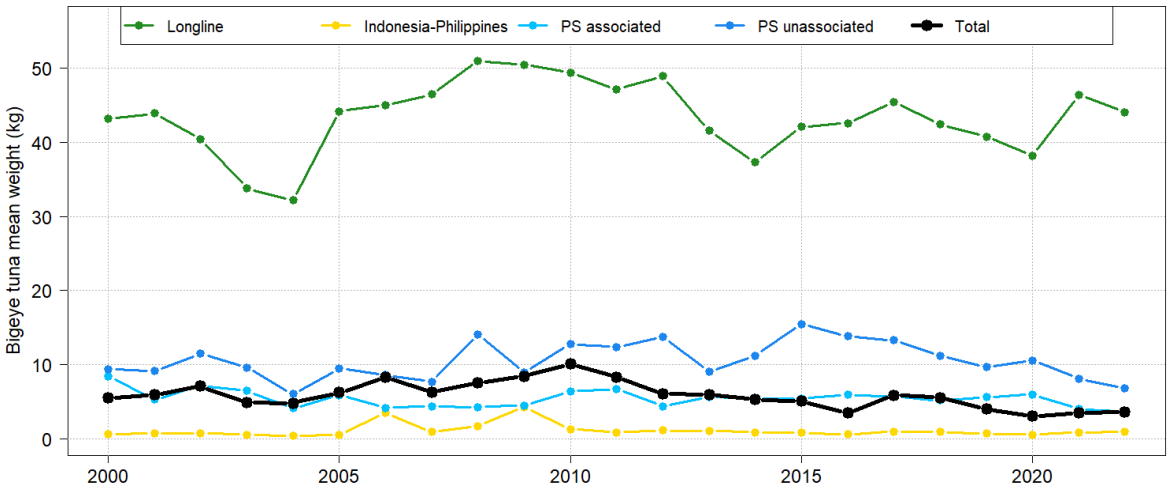

Figure 24: Mean weight of individual bigeye tuna taken by gear and year for the WCPO. The 'total' line represents the mean bigeye weight for the total catch.

Yellowfin

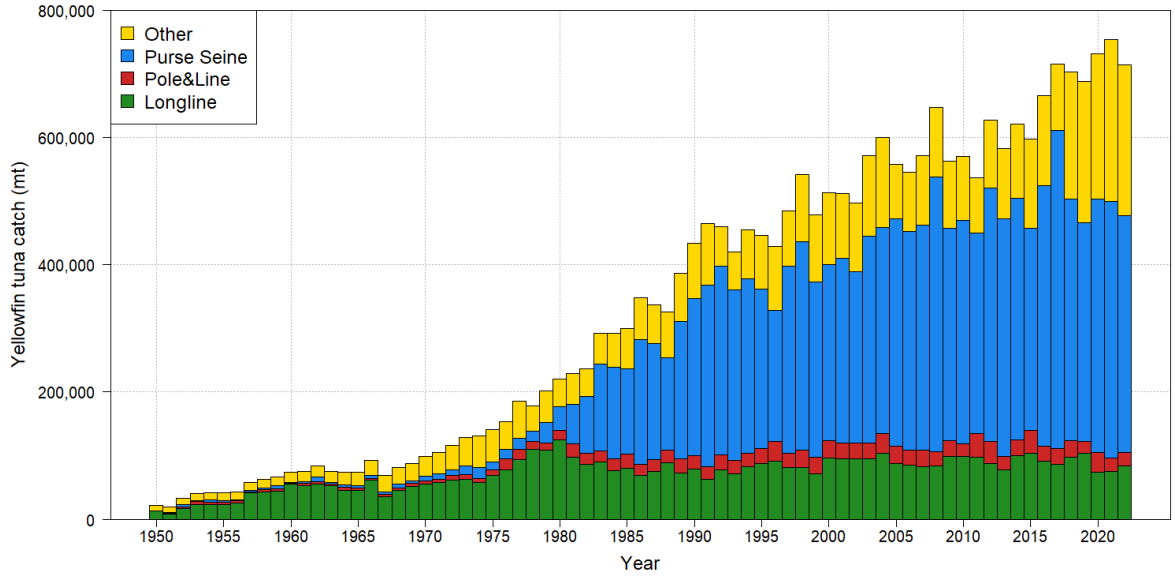

Figure 25: Yellowfin tuna catch (mt) by gear type and year for the WCPFC-Convention Area.

Figure 26: Yellowfin tuna catch per unit effort in the tropical WCPO by year for major pole and line fishing fleets (top), purse seine for the major set types (middle), and tropical longline for two fleets (bottom; 20^{o}N to 10^{o}S, WCPFC-CA). Note different time series lengths.

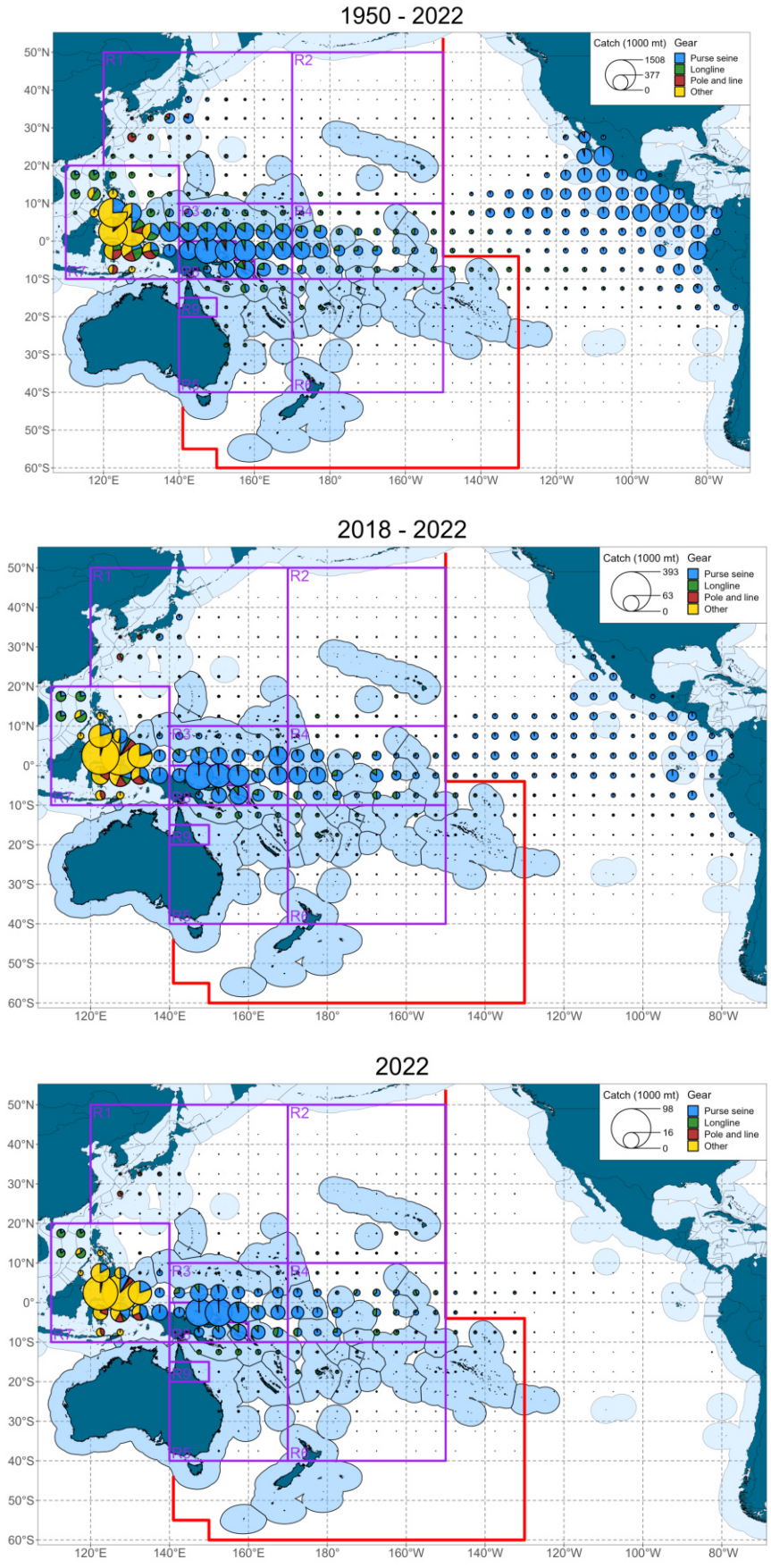

Figure 27: Yellowfin tuna catch distribution by gear type and 5^{o}x 5^o region for the Pacific Ocean for the period 1950-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note that the scale differs between panels and the figure legends provide the catch associated with each maximum circle size. The yellowfin assessment regions are outlined in purple, the WCPFC-CA is outlined in red. Catch data for the EPO in 2022 are incomplete.

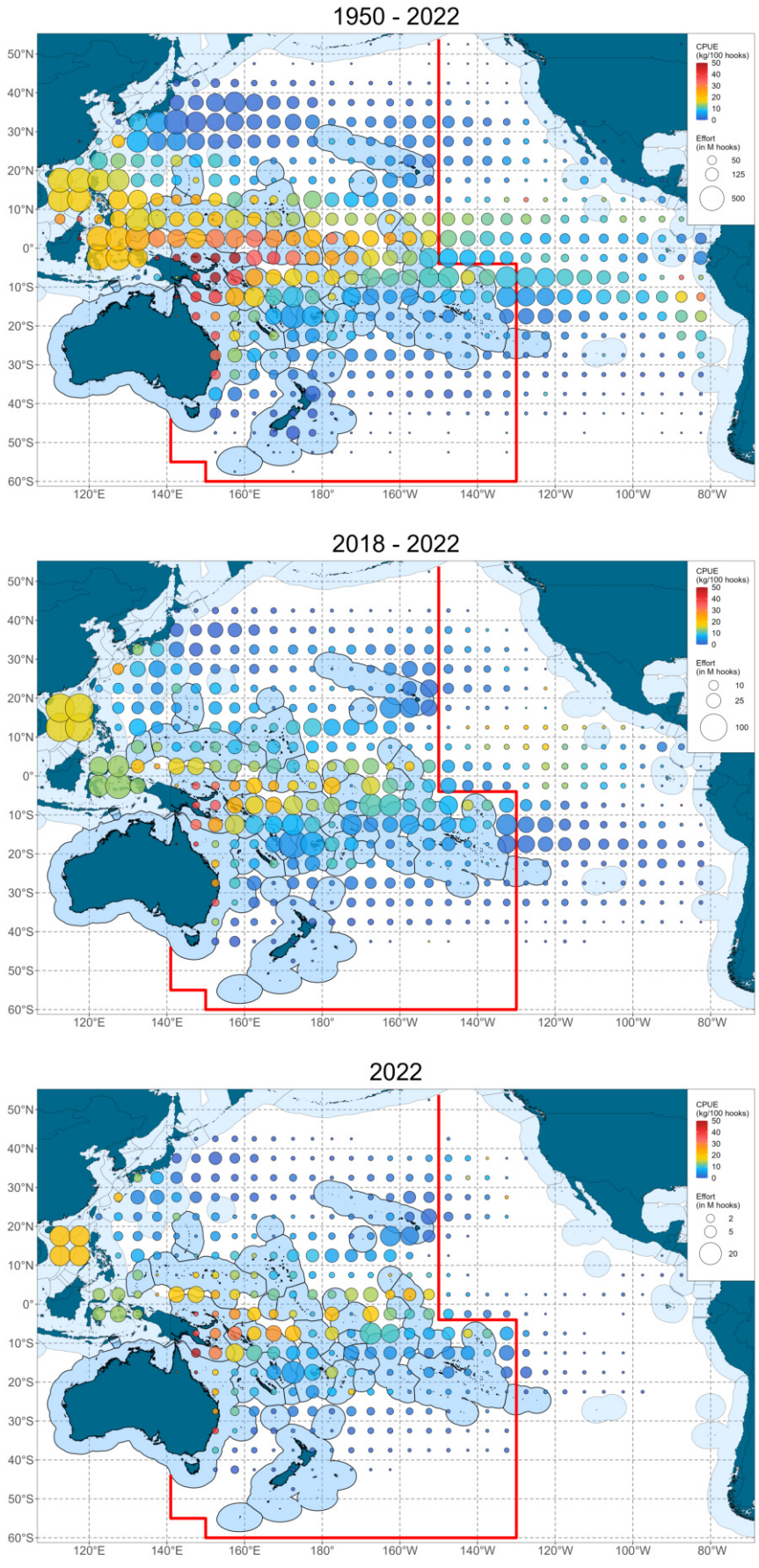

Figure 28: Distribution of 5^{o}x5^{o} longline effort (represented by circle size) and yellowfin tuna CPUE (represented by colour) for the period 1950-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note the differences in scales between plots. The WCPFC-CA is outlined in red. Catch data for the EPO in 2022 are incomplete.

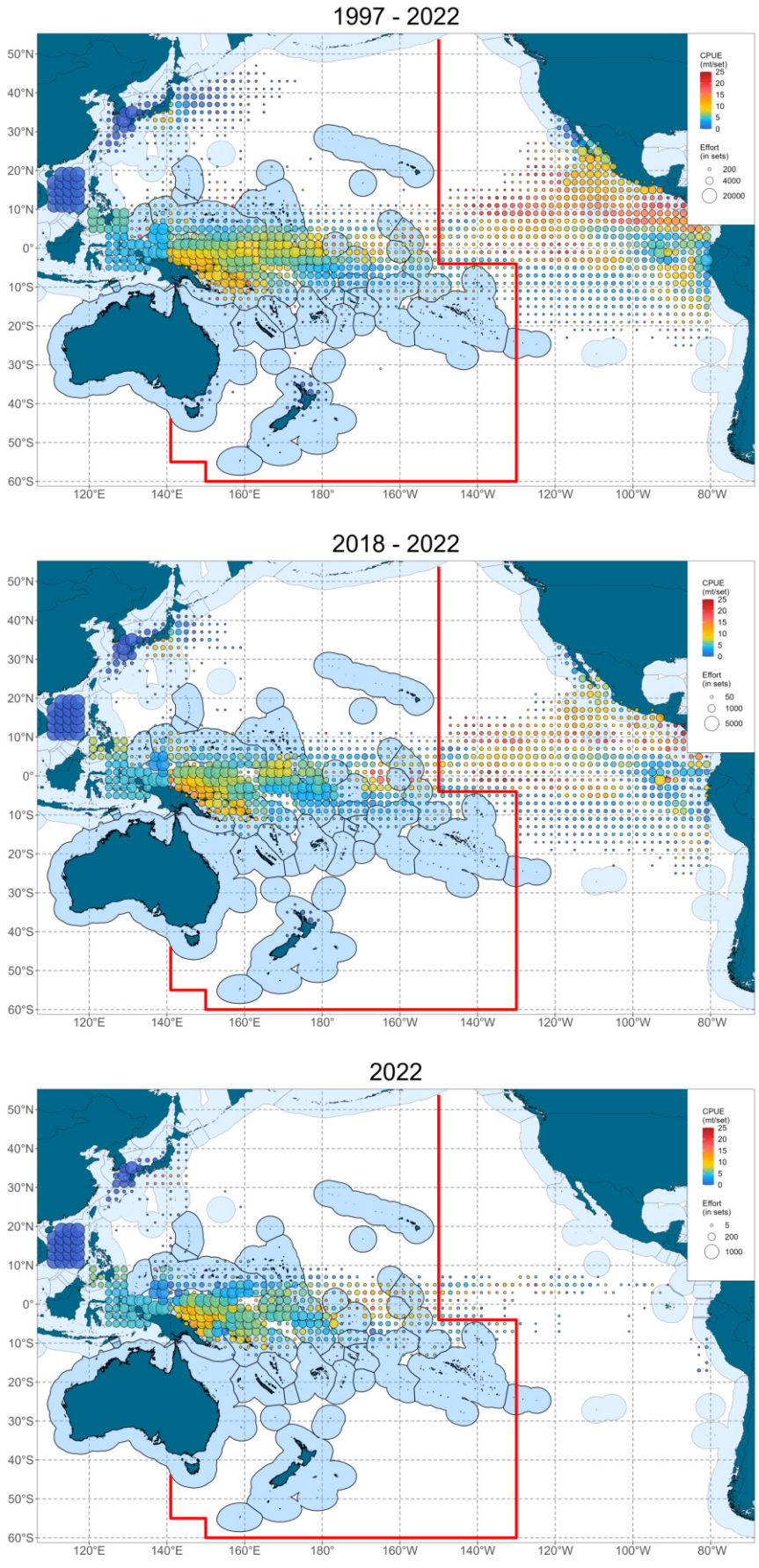

Figure 29: Distribution of 2^o x 2^o purse seine effort (represented by circle size) and yellowfin tuna CPUE (represented by colour) for the period 1997-2022 (top), 2018-2022 (middle) and 2022 (bottom). Note the differences in circle size scale between plots. The WCPFC-CA is outlined in red. Catch data for the EPO in 2022 are incomplete.

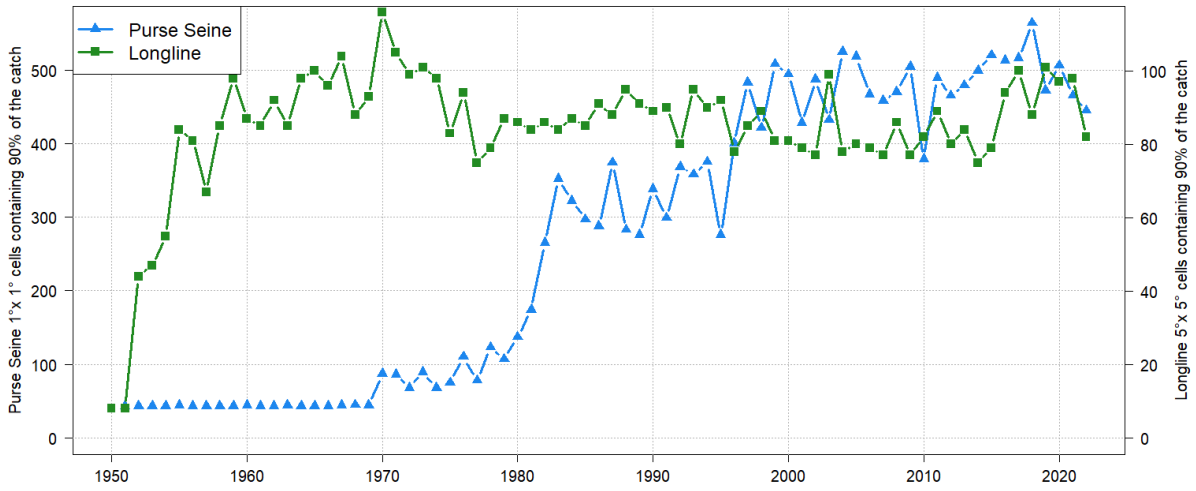

Figure 30: Spatial concentration of yellowfin tuna catch for purse seine and longline by year for the WCPO.

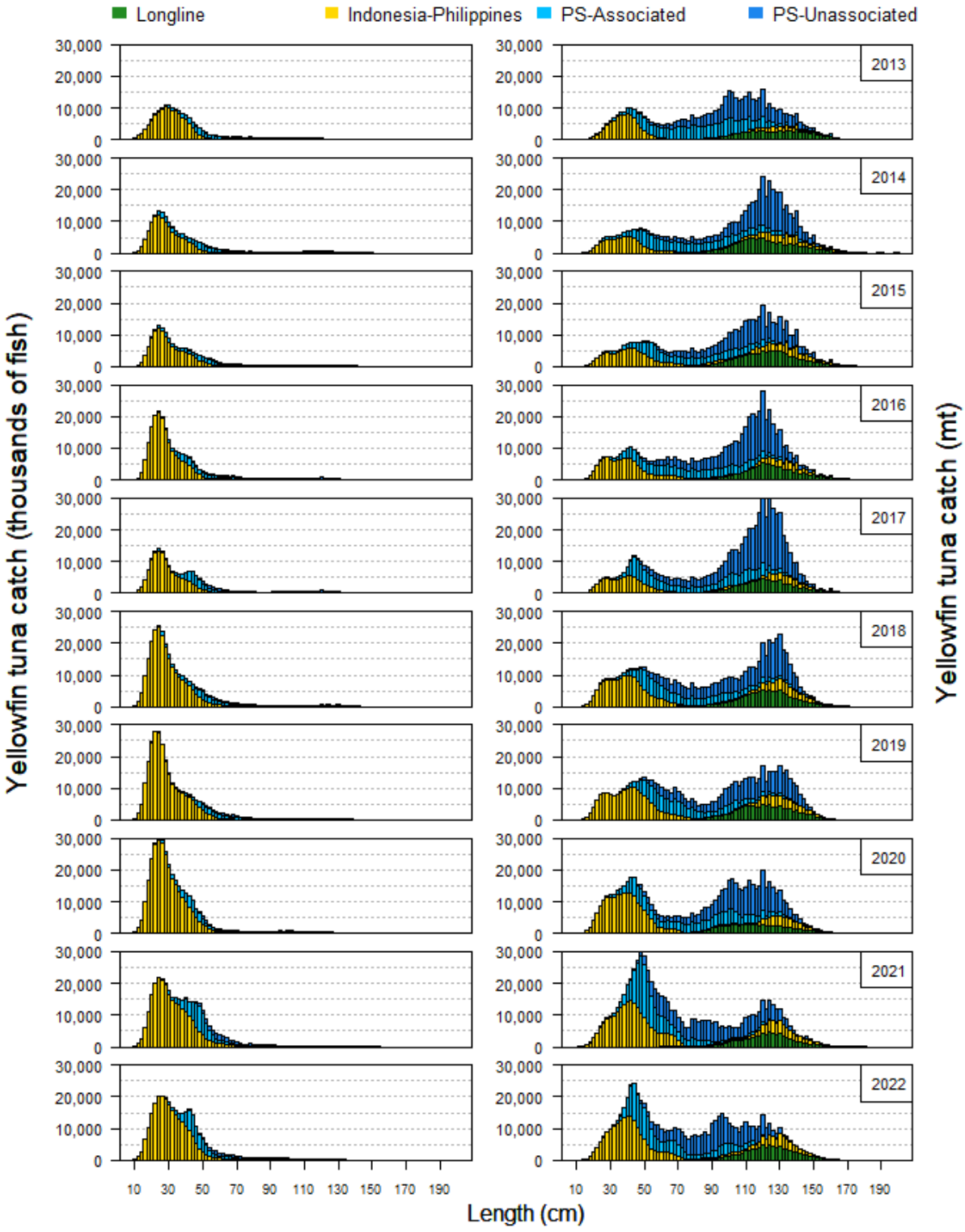

Figure 31: Catch-at-size of yellowfin tuna by gear type and year for the WCPO. Catch is provided in thousands of fish (left) and metric tonnes (right).

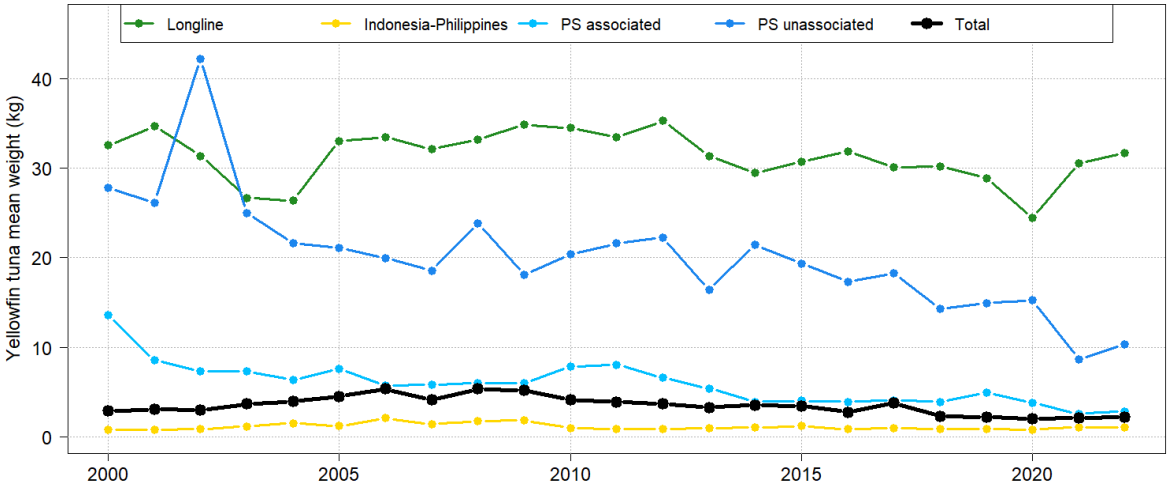

Figure 32: Mean weight of individual yellowfin tuna taken by gear and year for the WCPO. The 'total' line represents the mean yellowfin weight for the total catch.