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The western and central Pacific tuna fishery: 2020 overview and status of stocks

Tuna Fisheries Assessment Report no. 21

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Steven R. Hare, Peter G. Williams, Claudio Castillo Jordán, Paul A. Hamer, William J. Hampton, Robert D. Scott and Graham M. Pilling

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Preface

Tuna fisheries assessment reports provide current information on the tuna fisheries of the western and central Pacific Ocean (WCPO) and the fish stocks (mainly tuna) that are impacted by them. The information provided in this report is summary in nature, but a list of references (mostly accessible via the internet) is included for those seeking further details. This report is a smart PDF so if you click on a reference within the document it will take you to the figure/section; to return to the page you were on, press alt and the left arrow key.

This report focuses on the primary tuna stocks targeted by the main WCPO industrial fisheries – skipjack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*), bigeye (*T. obesus*) and South Pacific albacore tuna (*T. alalunga*).

The report is divided into three parts: the first section provides an overview of the fishery, with emphasis on developments over the past few years; the second summarises the most recent information on the status of the stocks; and the third summarises information concerning the interaction between the tuna fisheries, other associated and dependent species and their environment. The data used in compiling the report are those which were available to the Oceanic Fisheries Programme (OFP) at the time of publication, and are subject to change as improvements continue to be made to recent and historical catch statistics from the region. The fisheries statistics presented will usually be complete through the end of the year prior to publication. However, some minor revisions to statistics occasionally may be made for recent years. The stock assessment information presented is the most recent available at the time of publication.

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Further information, including a French version of this report, is available at the OFP webpage.

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1 The western and central Pacific tuna fishery

The tuna fisheries in the western and central Pacific Ocean (WCPO), encompassed by the Western and Central Pacific Fisheries Commission Convention Area (WCPFC-CA) (Figure 1), are diverse, ranging from small-scale, artisanal operations in the coastal waters of Pacific states, to large-scale, industrial purse seine, pole-and-line and longline operations in the exclusive economic zones (EEZs) of Pacific states and in international waters (high seas). The main species targeted by these fisheries are skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*T. obesus*) and albacore tuna (*T. alalunga*).

The current fishery characterisation includes updates to historical data, which show that 2020 was the 4th highest catch year in history. We expect revisions to the 2020 catch estimates in next year's report, as estimates in the most recent year are preliminary.

Annual total catch of the four main tuna species in the WCPFC-CA increased steadily during the 1980s as the purse seine fleet expanded, and remained relatively stable during most of the 1990s until a sharp increase in catch in 1998. Since then, there has been an upward trend in total tuna catch, primarily due to increases in purse seine catch, with some stabilisation since 2012 (Figure 2 and Table 1), at a total catch level of 2.6 to 3.0 million metric tonnes (hereafter abbreviated as "t"). The provisional total WCPFC-CA tuna catch for 2020 was estimated at 2,743,310 t – a clear drop from the record high of 2,987,934 t experienced in 2019. In 2020, the purse seine fishery accounted for an estimated 1,881,706 t (69% of the total catch), a drop from the record high of 2,101,408 t experienced in 2019 for this fishery. The pole-and-line fishery landed an estimated 235,000 t (9% of the catch), substantially lower than the highest value of 415,016 t recorded in 1984 a time of much greater pole-and-line vessel participation. The longline fishery in 2020 accounted for an estimated 217,398 t (8% of the catch) – also lower than the highest value (284,849 t), recorded in 2004. Troll gear accounted for <1% of the total catch (10,168 t), well below the highest value (25,845 t), recorded in 2000. The remaining 15% (399,038 t) was taken by a variety of artisanal gear, mostly in eastern Indonesia, the Philippines and Vietnam, which is a slight drop from the highest value (412,672 t), recorded in 2018. The WCPFC-CA tuna catch for 2020 represented 80% of the total Pacific Ocean catch (3,434,557 t) and 55% of the global tuna catch (the provisional estimate for 2020 being 5,025,947 t, a decrease of almost 7% from the 2019 record global catch).

The 2020 WCPFC-CA catch of skipjack (1,754,082 t – 64% of the total catch) was a drop from the highest value (2,041,738 t), recorded in 2019, a decrease of 14% (Table 2). The WCPFC-CA yellowfin catch for 2020 (727,012 t – 27% of the total catch) was a record catch, exceeding the previous high in 2017 by 17,000t. The WCPFC-CA bigeye catch for 2020 (156,639 t – 6% of the total catch) was well below the highest value (195,052 t), recorded in 2004, but a 15% increase over the 2019 catch. The WCPFC-CA albacore catch for 2020 (105,577 t – 4% of the total catch) was also well below the highest value (148,051 t), recorded in 2002, and a 9% decrease over the 2019 catch.

Within the WCPFC-CA, South Pacific and North Pacific albacore are assessed separately – SPC[1] conducts the South Pacific albacore assessment; the ISC[2] conducts the North Pacific albacore assessment, which covers the entire North Pacific, including the waters of the Inter-American Tropical Tuna Commission Convention Area (IATTC-CA). The albacore tuna catch in the WCPFC-CA north of the equator was 40,713 t in 2020, which is 11% lower than the average of the past five years, and less than half the highest catch of 104,798 t, taken in 1976 (Table 9). North Pacific albacore is not discussed further in this report; details of the latest assessment can be found in ISC ALBWG (2020).

In 2021, for the first time, a South–Pacific wide albacore stock assessment was conducted jointly by the SPC and IATTC, utilizing data from both Convention Areas (Table 7 and Table 8). South Pacific albacore catch in the western and central Pacific totalled 64,862 t in 2020, which is nearly 6% lower than than the average of the previous five years, and 20% lower than the highest value (80,986 t), recorded in 2010. Note that these values include catch within the overlap area with the IATTC-CA. For the eastern Pacific, exclusive of the overlap region, South Pacific albacore catch was 7,087 t in 2020; however this total is likely incomplete and the estimate may increase. Average catches over the period 2015–2019 were 15,342 t.

[1] The Pacific Community, formerly Secretariat of the Pacific Community.

[2] The International Scientific Committee for Tuna and Tuna-like Species in North Pacific Ocean, and the Albacore Working Group

Several indices of annual fishing effort for the major gears employed in the commercial tuna fisheries are summarised in Table 3, Figure 3 (purse seine), Figure 4 (longline) and Figure 5 (pole-and-line). For the purse seine fleet, excluding the Indonesian, Philippine and Vietnamese domestic vessels, the number of active vessels peaked in 2014 and 2015 at 313. The percentage of purse seiners flagged to, or chartered by, Pacific Island states has steadily increased from 0 as late as 1979 to a high of 52% (141 out of 271) in 2020. The increase in number of purse seine sets and purse seine fishing days has mirrored the rise in number of vessels, although the peak in both measures of fishing effort, sets and days, occured a few years earlier (2011–2013) at around 65,000 days/sets (suggesting improvements in efficiency). Purse seine vessels can make more than one set per day, and a day of searching (with no sets made) is counted as a fishing day.

The 2020 purse seine skipjack catch (1,412,484 t – 81% of the total skipjack catch) was 17% lower than the 2019 catch (Table 4). The 2020 purse seine catch of yellowfin tuna (392,598 t) was a 13% increase from 2019 (Table 5). The 2020 purse seine catch of bigeye tuna (73,243 t) was a 44% increase from 2019, and represented 47% of the total 2020 bigeye catch (Table 6). It is important to note that the purse seine species composition for 2020 will be revised once all observer data for 2020 have been received and processed, and the current estimate should therefore be considered preliminary. Note, however, that due to COVID-19[3] related restrictions on observer placements, coverage levels were less than 30% of purse seine sets and bycatch estimates are expected to be correspondingly imprecise relative to previous years (Peatman and Nicol 2021)

The commercial longline fleet (excluding Vietnamese and Indonesian domestic and Japanese coastal longliners) peaked in size in 1994 at a total of 5,068 vessels (Table 3 and Figure 4). The fleet has steadily declined since then, and totalled 1,581 vessels in 2020. The percentage of longliners flagged to Pacific Island countries has steadily increased from 0 in the mid-1970s to around 30% in 2012 and has remained around that level through 2020. While the number of longline vessels has declined over the history of the fishery, a more direct measure of effort – hooks fished – has shown a different trend. Total hooks fished in the WCPFC-CA increased from a level of 400 million in mid 1970s to 600 million in the early 2000s to 800 million in the early 2010s. The peak year in hooks fished was 2012 at 888 million hooks; the level in 2020 was 687 million hooks, a decline of 13% from the 2019 level.

The recent longline catch estimates are often uncertain and subject to revision due to delays in reporting. Nevertheless, the bigeye (60,762 t) catch was down 12% from 2019 and was the lowest since 1996, while the yellowfin (75,797 t) catch for 2020 was a 29% decrease on the 2019 catch and was the lowest since 1999.

The pole-and-line fleet has been contracting in size continuously since 1974, when the number of vessels peaked at 798, and totalled just 97 vessels in 2020, down from 104 in 2019 (Table 3 and Figure 5). Pole-and-line effort, measured in fishing days, has shown a similar decline, from a high of 88,567 days in 1977 to 8,460 days in 2020, noting, however that 2020 numbers are subject to revision.

Skipjack accounts for the majority of the pole-and-line tuna catch (85%), with yellowfin tuna (14%) making up the bulk of the remaining catch. The Japanese distant-water and offshore fleet and the Indonesian fleet account for most of the WCPFC-CA pole-and-line catch.

The 2020 troll catch in the WCPFC-CA was the highest catch since 2012, at 10,168 t, most of which was albacore tuna. Skipjack and yellowfin tuna are also taken in significant quantities in tropical small-scale troll fisheries, but most of these catches are reported under "Other gears". Since 2007, New Zealand (average 2,368 t catch per year) has had the most consistent effort in the South Pacific albacore troll fishery, with the United States landing a small catch (averaging 547 t per year) from the South Pacific.

2 Status of tuna stocks

The sections below provide a summary of the recent developments in fisheries for each species, and the results from the most recent stock assessments. A summary of the important biological reference points for the four stocks is provided in Table 10. Bigeye and yellowfin tuna stocks were last assessed in 2020, the

[3] Coronaviridae Study Group of the International Committee on Taxonomy of Viruses. The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat Microbiol* **5**, 536–544 (2020). https://doi.org/10.1038/s41564-020-0695-z

skipjack tuna stock was assessed in 2019, and the South Pacific albacore stock was assessed in 2021. Due to uncertainty in the fisheries data for the most recent year, data from the year immediately preceding the assessment year is not included in the bigeye, yellowfin and albacore assessments. Thus, the bigeye and yellowfin tuna assessments include data through 2018, while South Pacific albacore currently includes data through 2019. Skipjack, with its shorter lifespan and importance of young fish to the fishery, includes the most recent year of data; thus the 2019 assessment included fisheries data through 2018. Information on the status of other oceanic fisheries resources (e.g. billfishes and sharks) is provided in subsection 4.3 Ecosystem considerations.

2.1 Skipjack tuna

The 2020 WCPFC-CA skipjack catch of 1,754,082 t was a drop from the highest value (2,041,738 t), recorded in 2019 (Table 4 and Figure 6). As in recent years, the main contributor to the overall catch of skipjack was that taken in the purse seine fishery (1,412,484 t in 2020 – 81% of total skipjack catch). The next-highest proportion of the catch was by pole-and-line gear (185,385 t – 11%). The longline fishery accounted for less than 1% of the total catch. The vast majority of skipjack are taken in equatorial areas, and most of the remainder is taken in the seasonal domestic fishery off Japan (Figure 6).

The dominant size of the WCPFC-CA skipjack catch (by weight) typically ranges from 40 cm to 60 cm, corresponding to fish that are 1 to 2+ years old (Figure 6). For pole-and-line, the fish typically range from 40 cm to 55 cm, while skipjack in the domestic fisheries of Indonesia and the Philippines are much smaller (20–40 cm). In general, skipjack taken in unassociated (free-swimming) schools are larger than those taken in schools associated with Fish Aggregating Devices (FADs).

Stock assessment

The most recent assessment of skipjack in the WCPO was conducted in 2019, and included data from 1972 to 2018, using an eight region model (Vincent et al. 2019); readers are referred to that document for more details on model configuration and settings. The 2019 assessment included investigation of alternative regional structures (five and eight regions), growth functions, length composition scalars, tag mixing periods, and levels of steepness of the stock–recruitment relationship. The Scientific Committee (SC) of the Western and Central Pacific Fisheries Commission (WCPFC) agreed to use the eight region model to describe the stock status of skipjack tuna because they considered that it better captured the biology of skipjack tuna. Stock status was determined over an uncertainty grid of 54 models where models with a steepness of 0.65 or 0.95 were down weighted by 20% and models with a length composition scalar of 50 were also down weighted by 20%, while all other models were given a weighting of 1. While estimates of fishing mortality for skipjack have increased over time, current fishing mortality rates for skipjack tuna are estimated to be about 0.45 times the level of fishing mortality associated with maximum sustainable yield (F_{MSY}). Therefore, overfishing is not occurring (i.e. $F_{recent} < F_{MSY}$). Spawning biomass[4] is estimated to be at 44% of the level predicted in the absence of fishing. Recent spawning biomass levels are estimated to be well above the limit reference point of 20% of the level predicted in the absence of fishing ($SB/SB_{F=0} > 0.2$). Overall, the estimated recruitment shows an upward trend over time, but the spawning biomass shows a long-term decline. Under status quo fishing conditions, where catch and effort levels are maintained at the average 2016–2018 levels, the stock is projected to have zero probability of dropping below the Limit Reference Point (LRP). A number of diagnostic plots on exploitation history, present status and future projections are shown in Figure 7.

The conclusions of the WCPFC SC at its 15th Regular Session (SC15), which were presented as recommendations to the WCPFC, are outlined below.

- The median spawning biomass depletion level for the structural uncertainty grid is $SB_{recent}/SB_{F=0}$ = 0.44 with a likely range of 0.37 to 0.53 (80th percentile). There were no individual models where $SB_{recent}/SB_{F=0} < 0.2$, which indicated a zero probability that recent spawning biomass is below the LRP.
- The median F_{recent}/F_{MSY} for the model grid is 0.45, with a likely range of 0.34 to 0.60 (80th percentile) and no values of F_{recent}/F_{MSY} in the grid exceed 1. Therefore, there is zero probability that overfishing is occurring.

[4] As key tuna stock assessments generally incorporate the pattern of fecundity at size within the calculation of adult biomass (skipjack being the exception at present), this is more accurately called "spawning potential". However, we have used the term "spawning biomass" throughout this document, for simplicity.

- The largest uncertainty in the structural uncertainty grid is due to the assumed tag mixing period. SC15 acknowledged that further study is warranted to investigate the uncertainty surrounding the appropriate mixing period for the tagging data.
- The spatial extent of the Japanese pole-and-line fishery has decreased over the time period and the use of this standardised catch-per-unit-effort (CPUE) index within future stock assessments is uncertain. Therefore, further study of alternative indices of abundance is warranted, such as investigation of standardising the purse seine fishery CPUE and evaluation of the feasibility of conducting fishery independent surveys.

2.2 Yellowfin tuna

The total WCPFC-CA yellowfin catch in 2020, of 727,012 t, was a record catch (Table 5 and Figure 8). The purse seine catch (392,598 t) increased by 13%, and the longline catch (75,797 t) decreased by 40%, from 2019 levels. Possible contributors to the decreased longline catch for yellowfin, as well as the associated bigeye, tuna catch include: COVID-19 disruptions in the sashimi market supply chain may have led to transfer of fishing effort to other fisheries and the La Niña event of 2020 may have negatively affected CPUE in the eastern tropical fishery. The remainder of the yellowfin tuna catch comes from pole-and-line and troll, and the domestic fisheries in Indonesia, Vietnam and the Philippines. The purse seine catch of yellowfin tuna is typically around four times the size of the longline catch.

As with skipjack, most of the yellowfin catch is taken in equatorial areas by large purse seine vessels, and a variety of gears in the Indonesian and Philippines fisheries. The domestic surface fisheries of the Philippines and Indonesia take large numbers of small yellowfin in the range 20–50 cm (Figure 8). In the purse seine fishery, greater numbers of smaller yellowfin are caught in log and FAD sets than in unassociated sets. A major proportion (by weight) of the purse seine catch is adult (> 100 cm) yellowfin tuna.

Stock assessment

The most recent assessment of yellowfin tuna in the WCPO was conducted in 2020 (Vincent et al. 2020) and included data from 1952 to 2018. The 2020 assessment included further developments in the incorporation of an index fishery for each of the nine regions, use of additional information on yellowfin growth, and enforcement of mixing periods in the tagging data. The analysis presented the results as a structural uncertainty grid from 72 model runs and those results were equally weighted when developing management advice. Across the range of model runs in this assessment, the key factor influencing estimates of stock status was growth, with the most optimistic stock status estimates being those using a growth curve estimated externally from otolith data. Models where growth was estimated from modal size progression were the most pessimistic, while a third method, where growth was estimated from both conditional age-at-length and size composition data, was intermediate although closer to the otolith growth curve models. Additional axes of uncertainty in the yellowfin grid included multiple values for steepness in the stock–recruitment relationship, a range of scalars to weight the data, and an assumed mixing period of either 1 or 2 quarters for tagged fish.

Fishing mortality on both juvenile and adult fish has increased steadily since the early days of the fishery, although juvenile mortality shows signs of levelling off. Current fishing mortality rates for yellowfin tuna, however, are estimated to be below F_{MSY} in all models, which indicates that overfishing is not occurring. Spawning biomass showed a long continuous decline from the 1950s to the 2000s, but appears to have leveled off after around 2010. Recruitment has been variable throughout the assessment period, but somewhat lower in the past three decades relative to the 1950s and 1960s. Recent spawning biomass levels are uniformly (all models) estimated to be above the SB_{MSY} level and the LRP of 20% of the level predicted in the absence of fishing. Under status quo fishing conditions, where effort and catch levels are maintained at the average 2016–2018 levels, the stock is projected to have zero probability of dropping below the LRP. A number of diagnostic plots on exploitation history, present status and future projections are shown in Figure 9.

The conclusions of the WCPFC at its 16th Regular Session (SC16), which were presented as recommendations to the WCPFC in 2020, are outlined below.

- Based on the uncertainty grid adopted by SC16, the WCPO yellowfin tuna spawning biomass is above the biomass LRP and recent F is below F_{MSY}. The stock is not experiencing overfishing (0% probability F_{recent}>F_{MSY}) and is not in an overfished condition (0% probability

$SB_{recent}/SB_{F=0}$<LRP). Additionally, stochastic projections predict there is no risk of breaching the LRP (0% probability $SB_{2048}/SB_{F=0}<0.2$) under average 2016–2018 fishing conditions.

- Levels of fishing mortality and depletion differ between regions, and fishery impact was highest in the tropical region (Regions 3, 4, 7 and 8 in the stock assessment model), mainly due to the purse seine fisheries in the equatorial Pacific and the "other" fisheries within the western Pacific.
- WCPFC could consider reducing fishing mortality on yellowfin, from fisheries that take juveniles, with the goal to increase maximum fishery yields and reduce any further impacts on the spawning biomass for this stock in the tropical regions.
- Although the structural uncertainty grid presents a positive indication of stock status, the high level of unresolved conflict among the data inputs used in the assessment suggests additional caution may be appropriate when interpreting assessment outcomes to guide management decisions.
- We recommend as a precautionary approach that the fishing mortality on yellowfin tuna stock should not be increased from the level that maintains spawning biomass at 2012–2015 levels until the WCPFC can agree on an appropriate target reference point.

2.3 Bigeye tuna

The 2020 WCPFC-CA bigeye tuna catch was 156,639 t, which was well below the highest value (195,052 t), recorded in 2004. A 22,515 t increase in purse seine catch, an 8,663 t decrease in the longline fishery, and a nearly 7,000 t increase in the catch by "Other gears" (Table 6 and Figure 10) resulted in an overall 20,000 t increase in total bigeye catch relative to 2019. Of the total bigeye catch in 2020, 39% was caught by longline, 47% by purse seine, and the remainder was distributed across troll, pole-and-line, and other gears.

The majority of the WCPFC-CA catch is taken in equatorial areas, by both purse seine and longline, but with some longline catch in sub-tropical areas (e.g. east of Japan and off the east coast of Australia) (Figure 10). In the equatorial areas, much of the longline catch is taken in the central Pacific, contiguous with the important traditional bigeye longline area in the eastern Pacific.

As with skipjack and yellowfin tuna, the domestic surface fisheries of the Philippines and Indonesia take large numbers of small bigeye in the range of 20–50 cm. In addition, large numbers of 25–75 cm bigeye are taken in purse seine fishing on FADs (Figure 10) which, along with the fisheries of the Philippines and Indonesia, account for the bulk of the catch by number. The longline fishery, which lands bigeye mostly above 100 cm, accounts for most of the catch by weight in the WCPFC-CA. This contrasts with large yellowfin tuna, which (in addition to the longline gear) are also taken in significant amounts from unassociated schools in the purse seine fishery and in the Philippines handline fishery. Large bigeye are very rarely taken in the WCPO purse seine fishery, and only a relatively small amount comes from the handline fishery in the Philippines. Bigeye sampled in the longline fishery are predominantly adult fish, with a mean size of approximately 130 cm with most between 80 and 160 cm.

Stock assessment

The most recent assessment of bigeye tuna in the WCPO was conducted in 2020 (Ducharme-Barth et al. 2020), and included data from 1952 to 2018. This assessment utilised only the new growth estimates first introduced in the 2017 assessment (McKechnie et al. 2017) but also incorporated additional age-at-length information from tag recaptures and implemented the Richards growth model. Additionally, only the 10°N spatial structure was considered; an "index fishery" approach with utilisation of spatiotemporal model standardised CPUE indices was implemented for the nine regions, and updates were incorporated for tag data models, purse seine catch estimates, size composition data, and biological parameters for the length–weight relationship and reproductive biomass. Management advice was formulated from the results of an uncertainty grid of 24 models that addressed several key model uncertainties. The most influential factor contributing to uncertainty around estimated stock status was the level of data weighting given to the size–frequency data. Assessment outcomes became increasingly optimistic as greater weight was placed on the size–frequency data. Additional model uncertanties addressed in the grid included natural mortality and steepness in the stock–recruitment relationship.

Fishing mortality is estimated to have increased over time, particularly on juveniles over the last two decades, although juvenile mortality shows signs of levelling off. Current fishing mortality rates for bigeye tuna, however, are estimated to be below F_{MSY} in 21 of the 24 models in the grid, which indicates that overfishing is likely not occurring. Spawning biomass showed a long continuous decline from the 1950s to the 2000s, but appears to have levelled off since around 2010. Recruitment has been variable throughout the assessment period, but somewhat higher in the past two decades relative to the 1950s and 1960s. All models in the structural uncertainty grid estimated spawning biomass to be above both the SB_{MSY} level and the LRP of 20% of the level predicted in the absence of fishing. Under status quo fishing conditions, where effort and catch levels are maintained at the average 2016–2018 levels and relatively positive recent (2007–2016) recruitment patterns continue, the stock is projected to have zero probability of dropping below the LRP. A number of diagnostic plots on exploitation history, present status and future projections are shown in Figure 11.

The conclusions of WCPFC SC16, which were based on placing equal weight on all 24 model runs, were presented as recommendations to the WCPFC, and are outlined below.

- The median catch in the last year of the assessment (2018) was 159,288 t which was greater than the median MSY (140,720 t).
- Based on the uncertainty grid, WCPO bigeye tuna spawning biomass is above the biomass LRP and F_{recent} is very likely below F_{MSY}.
- It was concluded that the stock is not overfished (0% probability $SB/SB_{F=0}<0.2$) and likely not experiencing overfishing (87.5% probability $F_{recent}<F_{MSY}$).
- Levels of fishing mortality and depletion differ among regions, and the fishery impact was higher in the tropical regions (Regions 3, 4, 7 and 8 in the stock assessment model), with particularly high fishing mortality on juvenile bigeye tuna in these regions. There is also evidence that the overall stock status is buffered with biomass estimated at a more elevated level overall due to low exploitation in the temperate regions (1, 2, 6 and 9).
- Based on these results, it was recommended as a precautionary approach that the fishing mortality on the bigeye tuna stock should not be increased from the level that maintains spawning biomass at 2012–2015 levels until the WCPFC can agree on an appropriate target reference point.

2.4 South Pacific albacore tuna

The total WCPFC-CA South Pacific albacore catch in 2020 (64,862 t) was nearly 12% lower than the 2019 catch and was well below the historical high of 80,986 t in 2010 (Table 7 and Figure 12). Longline fishing has accounted for most of the catch of this stock (79% in the 1990s, but 95% in the most recent 10 years). The troll catch, mostly taken from November to April, has generally been in the range of 3,000–8,000 t; however it has averaged only 2,963 t over the past five years. Catches of South Pacific albacore in the eastern Pacific Ocean (EPO), i.e., in the IATTC-CA exclusive of the overlap area, are given in Table 8 and are included here because the EPO catch is included in the most recent stock assessment. Typically, the EPO catch is almost entirely taken in the longline fishery.

The longline catch is widely distributed across the South Pacific (Figure 12), with the largest catches from the western region. Much of the increase in catch in the early 2000s is attributed to that taken by vessels fishing north of latitude 20°S. The Pacific Island domestic longline fleet catch is restricted to latitudes 10°–25°S. Troll catch is distributed in New Zealand's coastal waters, mainly off the South Island, and along the sub-tropical convergence zone (STCZ). In the past, less than 20% of the overall South Pacific albacore catch was taken east of 150°W but, in the most recent five years, this has increased to over 25%.

The longline fishery takes mainly larger adult albacore, mostly in the narrow size range of 90–105 cm, and the troll fishery takes juvenile fish in the range of 45–80 cm. Juvenile albacore also occasionally appear in the longline catch in more southern latitudes.

Stock assessment

The most recent stock assessment for South Pacific albacore tuna was undertaken in 2021 (Castillo Jordán et al. 2021). Unlike the previous assessment that only considered the WCPFC-CA (Tremblay-Boyer et al. 2018), the 2021 assessment included the entire South Pacific region (south of the equator) incorporating the convention areas of both the WCPFC and the IATTC. The assessment was a collaborative effort by SPC and IATTC scientists; data covered the period 1960 to 2019.

The assessment presented the results from a structural uncertainty grid comprising 72 models. The uncertainty grid included axes for steepness of the stock–recruitment relationship (0.65, 0.80, and 0.95), recruitment distribution (estimated and SEAPODYM-derived), growth–natural mortality at age (fixed-otolith with M-at-age and length frequency with M-at-age), weighting of size composition data (10, 25 and 50) and movement (estimated and SEAPODYM-derived). The movement parameterization was the most influential in the model uncertainty grid, with differences on the order of 10% points for formulation of management advice. The SEAPODYM biophysical model (Senina et al. 2020) movement hypothesis was down weighted by the Scientific Committee for the provision of management advice. Management advice was provided for the entire South Pacific region, and the WCPFC and IATTC convention areas separately. We focus on the South Pacific–wide outcomes here.

South Pacific–wide, the assessment indicated the spawning stock biomass has continued to become more depleted across the model period (1960–2019), with depletion accelerating in the most recent years. Based on the set of models in the SC17 weighted structural uncertainty grid, the South Pacific albacore stock is not considered to be overfished, and there was zero estimated risk of the stock being below the Limit Reference Point of 20% $\mathrm{SB}_{F=0}$. Due to the decline in stock status estimated over the last several years, the $\mathrm{SB}_{latest}/\mathrm{SB}_{F=0}$ (year 2019; median 0.40; range 0.25–0.46) is more pessimistic than the $\mathrm{SB}_{recent}/\mathrm{SB}_{F=0}$ (years 2016–2019; median 0.52; range 0.37–0.59). Fishing mortality has generally been increasing over time, most notably for the adult component of the stock. The median F_{recent} (2015–2018 average) was estimated to be 0.24 times the fishing mortality that would support the MSY (range 0.13–0.47). Similarly, median $\mathrm{SB}_{recent}/\mathrm{SB}_{\mathrm{MSY}}$ was estimated at 3.22 (range 2.07–5.33). These estimates indicate the stock is not overfished or currently undergoing overfishing. The addition of the IATTC region into the South Pacific albacore assessment did not notably alter the main assessment outcomes, and similar trajectories and terminal depletion levels were estimated in both the WCPFC and IATTC convention areas (Castillo Jordán et al. 2021, WCPFC Secretariat 2021).

Stock projections (Pilling and Hamer 2021), with stochastic recruitment variation and the weighted uncertainty grid, suggest that under status quo fishing conditions, where catch levels are maintained at recent 2020 levels, the stock is projected to decline further in the short-term but equilibrate over the long-term at a median depletion ($\mathrm{SB}/\mathrm{SB}_{F=0}$) of 0.47, with 19% risk of being below the LRP of 20% $\mathrm{SB}_{F=0}$ and 17% risk of F being greater than $\mathrm{F}_{\mathrm{MSY}}$. SC17 expressed concern that the projections suggest the current catch levels will produce a notable risk of the stock breaching the LRP. Results of catch–based projections were similar for the WCPFC and IATTC convention areas.

The conclusions of the WCPFC SC at its 17th Regular Session (SC17), based on the 72 models from the weighted uncertainty grid were presented as recommendations to the WCPFC, and are outlined below.

- The median value of relative recent (2016–2019) spawning biomass depletion for South Pacific albacore ($\mathrm{SB}_{recent}/\mathrm{SB}_{F=0}$) was 0.52 with a 10th to 90th percentile interval of 0.41 to 0.57.
- There was 0% probability (0 out of 72 models) that the recent (2016–2019) spawning biomass had breached the adopted limit reference point (LRP)
- There has been a long-term increase in fishing mortality for adult South Pacific albacore, with a notable steep increase in fishing mortality since 2000.
- The median of relative recent fishing mortality for South Pacific albacore ($\mathrm{F}_{2015-2018}/F_{MSY}$) was 0.24 with a 10th to 90th percentile interval of 0.15 to 0.37.
- There was 0% probability (0 out of 72 models) that the recent (2015–2018) fishing mortality was above $\mathrm{F}_{\mathrm{MSY}}$.
- The stochastic projections, based on fishing at "status quo" conditions (2017–2019 or 2020 average catch or, separately, fishing effort) show a steep and rapid decline in biomass towards the LRP in the year 2021 followed by an increase in biomass thereafter. This held true for both the entire South Pacific as well as for only the WCPFC-CA.

2.5 Summary across target tuna stocks

To summarise the most recent stock assessments for the four target tuna stocks, stock status for all four species are plotted together on a single Majuro plot, along with the associated uncertainty from their respective model grids (Figure 14). All four are considered to be in a healthy, sustainable status as none are considered to be overfished. Yellowfin, skipjack and albacore are estimated to have a 0% probability of currently experiencing overfishing, while bigeye is estimated to have a 12.5% probability of undergoing overfishing. To place these results in context, a summary of stock status for these same four species assessed in other ocean basins by the three other tuna Regional Fisheries Management Organizations (RFMOs) is illustrated in Figure 14. As most of the other tuna RFMOs report stock status relative to MSY-based reference points (i.e., SB/SB_{MSY} and F/F_{MSY}), we based the WCPFC status on the same criteria.

2.6 Tuna tagging

Large-scale tagging experiments are required to provide the level of information (fishery exploitation rates and population size) that is necessary to inform stock assessments of tropical tunas in the WCPO. Tagging data have the potential to provide significant information of relevance to stock assessment, either by way of stand-alone analyses or, preferably, through their integration with other data directly in the stock assessment model. Tuna tagging has been a core activity of the Oceanic Fisheries Programme over the last 30 years, with tagging campaigns occurring in the 1970s, 1990s and, most recently, since 2006. This most recent campaign has now tagged and released 467,108 tuna in the equatorial WCPO, including over 1,800 archival tag releases, with 82,526 reported recaptures (Figure 15). A summary of tag releases and recoveries is provided in Table 11.

3 Ecosystem and bycatch issues

3.1 Catch composition

The tuna fisheries of the WCPO principally target four main tuna species: skipjack; yellowfin; bigeye; and albacore tuna. However, the fisheries also catch a range of other species in association with these. Some of the associated species (bycatch) are of commercial value (by-products), while many others are discarded. There are also incidents of the capture of species of ecological and/or social significance, including marine mammals, sea birds, sea turtles and some species of shark (e.g. whale sharks).

The information concerning the catch composition of the main tuna fisheries in the WCPO comes largely from the various observer programmes operating in the region. Overall, catch (in weight) from unassociated and associated purse seine sets are dominated by tuna species (99.7% and 97.9%, respectively), with anchored FAD sets having a slightly higher bycatch rate (96.1% tuna) than drifting FADs (Figure 16). Historically, associated sets have accounted for the majority of bycatch of finfish and shark species, although there is some variation from year to year due to changes in the proportions of sets by association type (Peatman et al. 2021).

Species composition of the catch has also been estimated for three main longline fisheries operating in the WCPO: the western tropical Pacific (WTP) shallow-setting longline fishery; the WTP deep-setting longline fishery; and the western South Pacific (WSP) albacore fishery. While estimates are uncertain due to the low level of observer coverage, some general conclusions are possible. The main tuna species account for 60.9%, 80.1% and 68.5% of the total catch (by weight) of the shallow-set, deep-set and albacore target longline fisheries respectively (Figure 17). The WTP shallow-set fishery has a higher proportion of non-tuna species in the catch, principally shark and billfish species, while mahi mahi (*Coryphaena hippurus*) and opah (*Lampris guttatus*) represent a significant component of the WSP albacore longline catch. There are also differences in the species composition of the billfish catch in the different longline fisheries. Blue sharks (*Prionace glauca*) and silky sharks (*Carcharhinus falciformis*) are the most common shark species across the longline fisheries (Figure 17).

3.2 Species of special interest

A range of conservation and management measures have been introduced by the WCPFC to reduce impacts of fisheries on species of special interest, including silky shark, whale shark (*Rhincodon typus*), and oceanic whitetip shark (*Carcharhinus longimanus*), sea turtles, whales and seabirds. Spatially and temporally disaggregated summaries of observer bycatch data are publicly available, including observed longline and purse seine effort and interaction rates for species of special interest.

There are limited interactions between the purse seine fishery and protected species, such as whale sharks and manta rays (*Mobula birostris*) (Figure 16). Historically, some vessels deliberately set around whale sharks associated with tuna schools, but this practice has been prohibited since 2014 in the WCPO. In a very small percentage of cases of free school sets, a whale shark is encountered; in these instances, the whale shark was not seen before the set was made. Observed interaction rates between the purse seine fishery and sea turtles are low ($<$ 1 interaction per 100 sets), and interactions with seabirds are very rare.

Interactions with seabirds and marine mammals are very low in all three longline fisheries (although the probability of detecting rare events with low observer coverage means that the estimates of very low interaction rates are very uncertain). Catch of five species of marine turtles has been observed in the equatorial longline fishery, although the observed encounter rate was particularly low, and most of the turtles caught were alive at the time of release.

3.3 Catch and status of billfish and sharks

In addition to the main tuna species, annual catch estimates for the WCPFC-CA in 2020 are available for the main species of billfish (swordfish (*Xiphias gladius*) [14,953 t], blue marlin (*Makaira nigricans*) [13,101 t], striped marlin (*Kajikia audax*) [3,492 t] and black marlin (*Istiompax indica*) [1,647 t]). For all of these species, current catch is around the average for the past decade. Catch of species associated with longline-caught tuna cannot be accurately quantified using logsheet data, but estimates should be possible in the future when longline observer coverage increases (see Peatman et al (2018) for more details). Observer coverage is already sufficiently high to estimate catch of bycatch species for large-scale purse seiners operating in equatorial and tropic waters.

The status of silky and oceanic whitetip sharks is of concern as assessments have shown that these stocks are subject to overfishing and, in the case of oceanic whitetip, severely overfished. A WCPFC ban on the use of either shark lines or wire traces in longline sets is in place, which it hoped will reduce the catch of silky and oceanic whitetip sharks. Over the past several years stock assessments have been undertaken for several billfish and shark species, in addition to the main tuna species. The SC recommendations to the WCPFC are broadly outlined below.

- Stabilise stock size or catch/ensure no increase in fishing pressure
  - Southwest Pacific swordfish
  - Pacific blue marlin
- Reduce catch and/or rebuild the stock and/or reduce effort and/or enhance data collection efforts
  - Pacific bluefin tuna
  - Southwest Pacific striped marlin
  - Western and central north Pacific striped marlin
  - Blue shark
  - Silky shark
  - Oceanic whitetip shark.

Three shark (oceanic whitetip and silky) and two billfish (Southwest Pacific striped marlin and Southwest Pacific swordfish) species have been assessed by SPC staff in recent years (Figure 18). Stock status for these species is based on the Kobe plot, where overfished status is judged relative to spawning stock size at MSY[5]. There is considerable uncertainty in the estimates of F/F_{MSY} and SB/SB_{MSY} for all five species. Based on the assessment model grid medians, Southwest Pacific striped marlin and oceanic whitetip are likely in an overfished state, while overfishing is likely occurring for silky shark as well as oceanic whitetip. Blue shark, assessed in 2021 (Neubauer et al. 2021), has improved in status in recent years and is likely neither overfished nor experiencing overfishing. Southwest Pacific swordfish, assessed in 2021 (Ducharme-Barth et al. 2021), is also likely neither overfished nor experiencing overfishing.

[5] Because the WCPFC has not agreed upon LRPs for billfish or shark, the Kobe plot, rather than the depletion-based Majuro plot, is the default.

3.4 El Niño Southern Oscillation forecast

One of the major factors influencing the distribution of tuna species, perhaps mostly notably for skipjack, is the El Niño Southern Oscillation (ENSO) (Lehodey et al. 1997). The two extremes of the oscillation, El Niño and La Niña, result in very different distributions of purse seine fishing effort (Figure 19). At the time this report went to press, a medium-strength La Niña event was in progress and forecast to continue across the Pacific from November 2021 to June 2022. The forecast is remarkably similar to the forecast at the same time last year. The 2020–21 La Niña did develop into a medium size event and a "back to back" occurence of La Niña events is relatively rare. Typically, La Niña events result in a pooling of warm water in the western Pacific, a relative decrease in sea surface temperature in the eastern Pacific, and a concentration of skipjack in the western Pacific, although we note that every ENSO event differs in its magnitude, range and impact.

3.5 Climate change

The Spatial Ecosystem And Population Dynamics (SEAPODYM, Lehodey et al. 2014) modelling framework was used to investigate how climate change could affect the distribution and abundance of skipjack, yellowfin, and bigeye tuna and South Pacific albacore, at the Pacific basin scale, and within the EEZs of Pacific Island countries and teritories (Senina et al. 2018). The analysis formed two parts, firstly, a model parameterisation phase over the historical period (1980–2010) using an analysis of historic ocean conditions, and then projections of an ensemble of simulations to explore key sources of uncertainty in climate models. Second, five different atmospheric forcing datasets from Earth System models projected under the ("business as usual") Intergovernmental Panel on Climate Change (IPCC) Regional Concentration Pathways 8.5 (RCP8.5) emissions scenario were used to drive physical-biogeochemical models through the 21^{st} century. Additional scenarios were included to explore uncertainty associated with future primary production and dissolved oxygen concentration, as well as possible adaptation through phenotypic plasticity of these tuna species to warmer spawning grounds. The impact of ocean acidification was also included for yellowfin tuna based on results from laboratory experiments.

The historical simulations (Figure 20) reflect key features of the ecology and behaviour of the four tuna species and match the total historical catch in terms of both weight and size–frequency distributions. The projections show an eastern shift in the biomass of skipjack and yellowfin tuna over time, with a large and increasing uncertainty for the second half of the century, especially for skipjack tuna. The impact is weaker for bigeye tuna and albacore, with prediction of a wider, warmer and more favourable range of spawning habitat. For albacore, a strong sensitivity to sub-surface oxygen conditions resulted in a very wide range of projected stock sizes. Historical fishing pressure was estimated to have reduced the adult stocks of all four tuna species by 30%–55% by the end of 2010. The effects of fishing on biomass strongly outweighed the decreases attributed to climate change in the short- to medium-term. Thus, fishing pressure is expected to be the dominant driver of tuna population status until the mid-century. The projected changes in abundance and redistribution of these tuna associated with climate change could have significant implications for the economic development of Pacific Island countries and territories, and the management of tuna resources, at the basin scale. In particular, larger proportions of the catch of each species are increasingly expected to be made in international waters (Bell et al. 2021).

4 For further information[6]

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[6] All WCPFC documents can be obtained by visiting the WCPFC website (www.wcpfc.int); hyperlinks are provided for documents listed herein.

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5 Tables

Table 1: Catch (metric tonnes) of the four tropical target tuna species by gear for the WCPFC-CA, from 1960 to 2020. Note: Data for 2020 are preliminary.

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
1960	129,874	98,956	5,224	0	31,195	265,249
1961	123,330	150,709	14,540	0	34,536	323,115
1962	128,804	166,141	18,875	0	34,947	348,767
1963	122,703	125,048	11,934	0	36,795	296,480
1964	102,481	167,181	29,012	0	41,334	340,008
1965	103,955	176,112	8,621	0	41,727	330,415
1966	145,278	241,730	16,913	0	46,993	450,914
1967	128,047	205,255	14,508	5	52,006	399,821
1968	120,136	183,954	15,143	14	52,327	371,574
1969	122,806	208,748	9,482	0	57,703	398,739
1970	141,360	230,142	16,222	50	69,633	457,407
1971	143,625	241,506	24,511	0	68,925	478,567
1972	161,533	242,745	29,030	268	87,209	520,785
1973	166,399	330,841	36,269	484	103,281	637,274
1974	145,192	370,499	29,547	898	109,578	655,714
1975	164,049	279,663	27,685	646	111,669	583,712
1976	198,013	382,627	40,770	25	104,582	726,017
1977	218,413	345,257	53,492	621	136,322	754,105
1978	212,059	407,482	52,041	1,686	131,084	804,352
1979	211,221	344,799	90,103	814	124,684	771,621
1980	230,625	398,498	116,755	1,489	89,969	837,336
1981	191,732	348,917	158,559	2,118	107,884	809,210
1982	179,575	316,457	255,491	2,552	107,990	862,065
1983	175,498	342,287	442,152	949	109,378	1,070,264
1984	162,111	415,016	462,277	3,124	118,478	1,161,006
1985	177,722	287,892	409,536	3,468	136,812	1,015,430
1986	169,129	360,864	660,297	2,284	146,873	1,339,447
1987	179,966	294,879	543,980	2,350	131,849	1,153,024
1988	200,774	327,997	608,996	4,671	151,193	1,293,631
1989	170,876	311,981	664,660	8,687	165,164	1,321,368
1990	188,842	247,104	795,530	7,219	203,508	1,442,203
1991	160,889	290,006	1,006,764	8,004	203,129	1,668,792
1992	199,688	259,762	975,738	6,844	163,536	1,605,568
1993	195,377	293,014	846,114	4,612	145,262	1,484,379
1994	221,367	262,721	971,563	7,493	162,850	1,625,994
1995	217,417	298,301	927,491	23,585	168,062	1,634,856
1996	215,466	301,279	896,443	17,807	208,032	1,639,027
1997	226,375	298,666	959,218	18,732	178,199	1,681,190
1998	251,197	323,645	1,257,392	19,099	213,779	2,065,112
1999	219,024	338,480	1,068,956	13,476	211,900	1,851,836
2000	248,474	319,854	1,143,294	25,845	235,670	1,973,137
2001	264,340	272,483	1,118,917	17,329	211,934	1,885,003
2002	281,627	286,202	1,265,452	16,129	222,513	2,071,923
2003	261,636	303,905	1,265,758	19,875	250,944	2,102,118
2004	284,849	322,179	1,354,239	23,445	290,666	2,275,378
2005	250,698	266,735	1,484,881	13,293	228,562	2,244,169
2006	255,653	257,594	1,525,500	10,098	255,646	2,304,491
2007	245,130	284,661	1,691,791	9,249	304,526	2,535,357
2008	247,755	269,551	1,738,057	11,740	312,905	2,580,008
2009	280,374	264,350	1,801,653	9,898	277,286	2,633,561
2010	278,578	270,123	1,708,272	11,320	260,010	2,528,303

Continued on next page

Table 1: *(continued)*

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
2011	261,756	275,070	1,576,066	11,973	239,331	2,364,196
2012	275,053	242,960	1,851,983	14,018	298,991	2,683,005
2013	242,834	229,560	1,934,752	9,484	313,059	2,729,689
2014	264,683	206,939	2,079,879	6,677	347,784	2,905,962
2015	271,113	214,041	1,772,737	7,564	396,680	2,662,135
2016	240,729	198,398	1,862,825	7,207	411,392	2,720,551
2017	246,325	171,570	1,833,283	7,974	331,784	2,590,936
2018	257,247	232,255	1,908,954	7,464	412,672	2,818,592
2019	271,955	195,402	2,101,408	8,060	411,109	2,987,934
2020	217,398	235,000	1,881,706	10,168	399,038	2,743,310

Table 2: Catch (metric tonnes) by species for the four main tuna species taken in the WCPFC-CA, from 1960 to 2020. Note: Data for 2020 are preliminary.

Year	Albacore	Bigeye	Skipjack	Yellowfin	Total
1960	56,619	45,025	89,938	73,667	265,249
1961	51,561	39,380	156,736	75,438	323,115
1962	46,331	36,868	181,624	83,944	348,767
1963	53,675	44,346	122,703	75,756	296,480
1964	50,545	32,391	182,918	74,154	340,008
1965	70,226	31,333	155,221	73,635	330,415
1966	75,114	33,187	249,514	93,099	450,914
1967	89,303	36,750	204,829	68,939	399,821
1968	64,213	30,427	194,990	81,944	371,574
1969	72,106	36,032	203,329	87,272	398,739
1970	74,350	41,702	242,366	98,989	457,407
1971	100,737	44,142	228,722	104,966	478,567
1972	109,655	57,163	238,082	115,885	520,785
1973	131,149	48,889	329,050	128,186	637,274
1974	115,162	52,758	356,557	131,237	655,714
1975	84,651	69,314	288,468	141,279	583,712
1976	132,947	83,110	356,862	153,098	726,017
1977	83,171	84,055	401,708	185,171	754,105
1978	111,161	66,964	448,039	178,188	804,352
1979	86,007	74,557	408,847	202,210	771,621
1980	95,156	73,355	448,633	220,192	837,336
1981	88,095	66,352	426,215	228,548	809,210
1982	89,496	76,730	459,614	236,225	862,065
1983	65,988	82,856	629,453	291,967	1,070,264
1984	74,540	89,648	703,988	292,830	1,161,006
1985	77,060	90,508	547,717	300,145	1,015,430
1986	71,757	110,363	809,112	348,215	1,339,447
1987	63,645	113,979	638,743	336,657	1,153,024
1988	67,948	110,236	789,843	325,604	1,293,631
1989	73,533	110,967	749,978	386,890	1,321,368
1990	63,872	134,376	809,942	434,013	1,442,203
1991	58,322	119,886	1,025,148	465,436	1,668,792
1992	74,452	143,145	928,151	459,820	1,605,568
1993	77,496	121,643	864,459	420,781	1,484,379
1994	96,461	135,473	939,534	454,526	1,625,994
1995	91,750	119,681	977,514	445,911	1,634,856
1996	91,140	115,273	1,003,276	429,338	1,639,027
1997	112,900	141,099	943,070	484,121	1,681,190
1998	112,465	161,641	1,248,763	542,243	2,065,112
1999	131,066	170,450	1,072,197	478,123	1,851,836
2000	101,672	160,442	1,197,535	513,488	1,973,137
2001	121,561	147,535	1,104,396	511,511	1,885,003
2002	148,051	169,452	1,257,444	496,976	2,071,923
2003	123,239	157,258	1,250,353	571,268	2,102,118
2004	122,399	195,052	1,357,372	600,555	2,275,378
2005	105,371	163,189	1,418,111	557,498	2,244,169
2006	105,257	171,437	1,481,979	545,818	2,304,491
2007	126,857	170,753	1,666,126	571,621	2,535,357
2008	105,109	178,927	1,648,181	647,791	2,580,008
2009	135,622	174,965	1,760,616	562,358	2,633,561
2010	129,224	148,566	1,680,246	570,267	2,528,303
2011	115,766	176,375	1,534,896	537,159	2,364,196
2012	143,792	177,631	1,733,705	627,877	2,683,005
2013	138,397	167,323	1,840,855	583,114	2,729,689

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Table 2: *(continued)*

Year	**Albacore**	**Bigeye**	**Skipjack**	**Yellowfin**	**Total**
2014	121,720	176,901	1,985,679	621,662	2,905,962
2015	117,482	155,008	1,792,612	597,033	2,662,135
2016	101,245	162,536	1,792,402	664,368	2,720,551
2017	126,547	138,429	1,615,357	710,603	2,590,936
2018	110,949	158,704	1,850,039	698,900	2,818,592
2019	115,653	136,511	2,041,738	694,032	2,987,934
2020	105,577	156,639	1,754,082	727,012	2,743,310

Table 3: Several indices of fishing effort for the three main gears used in commercial fishing of tuna in the western and central Pacific region, from 1960–2020. For vessels, the abbreviations are: DPI – domestic (Pacific Island); DNPI – domestic (non-Pacific Island), DWFN – distant water fishing nation. Longline effort (Mhks) is millions of hooks. Effort totals exclude the following: Japan coastal, Indonesia, Philippine and Vietnam domestic purse seine vessels; Vietnam and Indonesia domestic longline vessels; Japanese coastal and Indonesian domestic vessels for pole-and-line.

	Purse seine				Longline				Pole-and-line			
	Vessels		Effort		Vessels			Effort	Vessels			Effort
Year	DPI	DWFN	Days	Sets	DPI	DNPI	DWFN	Mhks	Japan	DPI	DNPI	Days
1960	0	0	0	0	0	881	1,845	254.4	0	0	0	0
1961	0	0	0	0	0	730	1,937	281.3	0	0	0	0
1962	0	0	0	0	0	695	1,848	259.1	0	0	0	0
1963	0	0	0	0	0	806	1,911	316.4	0	0	0	0
1964	0	0	0	0	0	641	1,821	221.6	0	0	0	0
1965	0	0	0	0	0	726	1,752	294.2	0	0	0	0
1966	0	0	0	0	0	175	1,861	307.3	0	0	0	0
1967	0	0	8	13	0	173	1,831	342.7	0	0	0	0
1968	0	0	51	77	0	253	1,845	359.3	0	0	0	0
1969	0	4	17	22	0	918	1,739	307.7	0	0	0	0
1970	0	6	99	120	0	1743	1,658	342.1	0	0	0	0
1971	0	6	1,939	2,654	0	1,794	1,684	378.9	0	0	0	0
1972	0	7	2,465	3,433	0	1,862	1,609	342.2	554	56	0	54,754
1973	0	6	2,657	3,591	2	2,232	1,650	364.8	650	66	0	65,381
1974	0	10	1,942	2,337	0	1,986	1,786	407.4	716	82	0	66,810
1975	0	12	2,197	2,629	0	2,147	1,763	354.2	696	81	0	66,314
1976	0	18	2,534	3,159	2	2,174	1,847	367.9	653	89	9	74,787
1977	0	15	2,253	2,721	2	2,125	1,821	363.7	662	100	20	88,567
1978	0	19	2,491	2,994	2	2,358	1,871	360.5	645	100	14	83,754
1979	0	27	3,639	4,463	2	2,505	1,868	471.0	625	98	10	79,590
1980	1	33	3,798	4,961	2	2,743	1,913	498.1	572	160	9	79,191
1981	1	42	7,763	8,114	2	2,645	1,871	461.8	548	168	18	80,060
1982	1	73	11,770	11,560	3	2,641	1,592	409.1	475	108	23	68,126
1983	8	118	18,993	16,062	4	2,527	1,437	351.3	434	91	16	58,692
1984	6	120	25,083	21,471	5	2,563	1,445	376.4	396	98	8	59,279
1985	6	110	20,819	18,418	6	2,872	1,437	386.8	356	98	0	53,866
1986	5	113	20,805	18,160	3	2,795	1,445	332.0	330	97	5	51,413
1987	5	116	24,329	19,823	4	3,179	1,415	363.7	314	112	5	48,305
1988	8	132	24,261	19,441	5	2,844	1,393	441.7	277	102	18	42,862
1989	5	152	27,110	22,115	9	2,695	1,405	401.0	269	105	15	43,480
1990	13	176	30,060	23,081	16	2,283	1,410	391.9	255	166	20	42,075
1991	15	184	37,153	31,093	27	1,965	1,455	384.6	242	154	19	32,256
1992	17	193	40,825	30,618	59	3,173	1,396	506.2	216	163	13	32,447
1993	15	183	42,751	31,219	113	3,241	1,570	393.9	203	138	19	32,113
1994	22	176	38,091	29,254	158	3,223	1,687	444.9	185	137	23	31,233
1995	21	163	37,015	28,526	217	2,984	1,624	461.8	174	145	33	31,229
1996	20	158	37,758	29,971	259	2,599	1,428	385.8	165	139	33	29,449
1997	31	158	39,328	30,681	349	3,194	1,231	377.6	163	108	26	33,060
1998	32	164	36,532	31,750	415	3,089	1,223	453.2	163	102	16	33,995
1999	40	164	38,521	27,260	405	3,075	1,151	513.9	163	103	16	33,600
2000	52	174	37,790	30,754	422	1,426	1,089	515.6	160	83	15	28,622
2001	46	161	37,977	30,398	490	2,312	1,118	592.1	155	75	11	25,809
2002	55	158	41,777	33,415	463	2,245	1,149	675.2	151	70	11	27,327
2003	59	152	44,031	33,646	482	1,622	1,139	718.9	144	69	9	22,759
2004	78	147	47,264	35,340	476	1,515	910	712.2	127	67	9	22,122
2005	86	142	49,123	40,486	475	1,473	763	650.0	128	60	11	22,122
2006	76	148	45,095	36,280	433	1,313	639	640.6	113	65	6	18,424
2007	83	162	48,256	39,430	458	1,163	518	716.0	106	58	5	18,413

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Table 3: *(continued)*

	Purse seine				Longline				Pole-and-line			
	Vessels		Effort		Vessels			Effort	Vessels			Effort
Year	DPI	DWFN	Days	Sets	DPI	DNPI	DWFN	Mhks	Japan	DPI	DNPI	Days
2008	80	175	52,363	44,849	432	1,147	604	733.8	98	50	3	16,887
2009	80	187	52,946	47,191	401	1,148	589	764.6	96	48	6	16,001
2010	87	196	55,155	54,425	509	1,165	632	774.8	95	50	2	16,153
2011	94	191	65,971	60,828	608	1,131	660	819.9	91	56	2	14,833
2012	100	191	61,690	64,903	540	630	645	887.6	87	54	1	15,241
2013	104	199	62,552	64,918	380	738	744	725.1	80	49	2	13,786
2014	109	204	60,427	65,073	540	724	656	738.0	80	47	0	11,348
2015	118	195	49,462	55,592	538	820	705	767.6	76	47	0	12,817
2016	138	160	50,352	53,542	373	783	701	691.8	76	45	0	14,464
2017	136	152	53,623	57,348	547	709	633	718.1	80	46	0	13,307
2018	132	145	50,505	57,390	609	709	631	730.2	70	40	0	13,980
2019	138	152	47,997	58,833	454	601	626	789.3	67	37	0	13,177
2020	141	130	49,654	53,622	414	562	605	686.8	59	37	1	8,460

Table 4: Skipjack tuna catch (metric tonnes) by gear type for the WCPFC-CA, from 1960 to 2020. Note: Data for 2020 are preliminary.

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
1960	0	70,428	3,728	0	15,782	89,938
1961	0	127,011	11,693	0	18,032	156,736
1962	4	152,387	11,674	0	17,559	181,624
1963	0	94,757	9,592	0	18,354	122,703
1964	5	137,106	25,006	0	20,801	182,918
1965	11	129,933	4,657	0	20,620	155,221
1966	52	215,600	10,949	0	22,913	249,514
1967	124	168,846	10,929	0	24,930	204,829
1968	83	162,379	7,599	0	24,929	194,990
1969	130	168,084	5,045	0	30,070	203,329
1970	1,608	197,873	7,670	0	35,215	242,366
1971	1,475	180,945	13,873	0	32,429	228,722
1972	1,544	172,827	18,343	0	45,368	238,082
1973	1,861	253,217	19,537	0	54,435	329,050
1974	2,124	289,202	11,209	0	54,022	356,557
1975	1,919	218,271	13,259	0	55,019	288,468
1976	2,096	276,582	22,077	0	56,107	356,862
1977	3,127	294,641	32,700	0	71,240	401,708
1978	3,233	331,401	32,176	0	81,229	448,039
1979	2,179	285,859	54,667	0	66,142	408,847
1980	632	333,597	76,108	12	38,284	448,633
1981	756	296,065	85,153	17	44,224	426,215
1982	972	264,726	145,814	64	48,038	459,614
1983	2,144	298,928	278,721	154	49,506	629,453
1984	870	366,811	287,899	284	48,124	703,988
1985	1,108	238,932	253,771	146	53,760	547,717
1986	1,439	322,665	420,043	219	64,746	809,112
1987	2,329	252,142	325,570	168	58,534	638,743
1988	1,937	295,325	434,004	299	58,278	789,843
1989	2,507	275,088	413,702	244	58,437	749,978
1990	363	211,573	503,247	176	94,583	809,942
1991	885	259,778	672,760	148	91,577	1,025,148
1992	432	218,765	617,897	168	90,889	928,151
1993	573	255,152	530,677	175	77,882	864,459
1994	379	209,636	652,327	228	76,964	939,534
1995	598	247,744	638,531	12,298	78,343	977,514
1996	3,935	242,486	651,106	6,514	99,235	1,003,276
1997	4,070	236,999	606,523	9,218	86,260	943,070
1998	5,030	266,772	866,959	8,316	101,686	1,248,763
1999	4,208	255,330	706,421	5,660	100,578	1,072,197
2000	4,559	264,407	797,991	15,005	115,573	1,197,535
2001	5,059	212,668	774,718	7,536	104,415	1,104,396
2002	3,450	207,488	932,334	6,796	107,376	1,257,444
2003	3,824	238,179	882,074	9,721	116,555	1,250,353
2004	4,051	249,936	950,066	15,118	138,201	1,357,372
2005	1,084	216,715	1,054,924	6,302	139,086	1,418,111
2006	1,528	208,731	1,110,083	3,987	157,650	1,481,979
2007	1,175	213,010	1,257,726	3,598	190,617	1,666,126
2008	803	218,570	1,226,046	4,572	198,190	1,648,181
2009	1,220	201,323	1,383,759	4,252	170,062	1,760,616
2010	1,192	223,409	1,292,137	4,705	158,803	1,680,246
2011	1,124	206,843	1,173,072	4,214	149,643	1,534,896
2012	2,004	170,538	1,372,974	6,235	181,954	1,733,705
2013	1,254	169,025	1,475,711	3,223	191,642	1,840,855

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Table 4: *(continued)*

Year	**Longline**	**Pole-and-line**	**Purse seine**	**Troll**	**Other**	**Total**
2014	1,879	148,684	1,616,536	1,567	217,013	1,985,679
2015	1,879	151,317	1,393,137	1,776	244,503	1,792,612
2016	5,642	156,603	1,378,518	1,919	249,720	1,792,402
2017	2,571	123,466	1,268,212	2,251	218,857	1,615,357
2018	4,162	183,935	1,455,746	1,947	204,249	1,850,039
2019	5,593	158,225	1,699,991	2,148	175,781	2,041,738
2020	2,369	185,385	1,412,484	2,177	151,667	1,754,082

Table 5: Yellowfin tuna catch (metric tonnes) by gear type for the WCPFC-CA, from 1960 to 2020. Note: Data for 2020 are preliminary.

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
1960	55,020	1,872	1,438	0	15,337	73,667
1961	53,166	3,259	2,777	0	16,236	75,438
1962	55,547	4,225	6,975	0	17,197	83,944
1963	53,185	2,071	2,277	0	18,223	75,756
1964	45,247	5,074	3,647	0	20,186	74,154
1965	45,493	3,434	3,752	0	20,956	73,635
1966	61,654	2,192	5,844	0	23,409	93,099
1967	36,083	3,125	3,428	0	26,303	68,939
1968	46,070	2,706	7,083	0	26,085	81,944
1969	51,627	5,166	3,867	0	26,612	87,272
1970	55,806	4,606	7,644	0	30,933	98,989
1971	57,766	5,248	9,058	0	32,894	104,966
1972	61,175	7,465	9,739	0	37,506	115,885
1973	62,291	7,458	14,609	0	43,828	128,186
1974	58,116	6,582	17,098	0	49,441	131,237
1975	69,462	7,801	12,987	0	51,029	141,279
1976	77,570	17,186	15,576	0	42,766	153,098
1977	94,414	15,257	17,430	0	58,070	185,171
1978	110,202	12,767	15,818	0	39,401	178,188
1979	108,910	11,638	32,097	0	49,565	202,210
1980	125,113	15,142	36,502	9	43,426	220,192
1981	97,114	22,044	61,398	16	47,976	228,548
1982	86,149	17,123	90,099	54	42,800	236,225
1983	90,259	17,184	136,317	51	48,156	291,967
1984	76,988	17,633	143,930	67	54,212	292,830
1985	79,973	22,717	134,057	69	63,329	300,145
1986	68,999	17,970	195,817	62	65,367	348,215
1987	75,407	19,044	182,212	48	59,946	336,657
1988	88,855	20,566	144,529	76	71,578	325,604
1989	73,306	22,133	215,964	73	75,414	386,890
1990	79,300	20,769	247,028	68	86,848	434,013
1991	63,512	19,182	285,775	51	96,916	465,436
1992	77,739	23,043	296,814	98	62,126	459,820
1993	72,055	20,486	267,646	141	60,453	420,781
1994	82,184	21,378	273,986	101	76,877	454,526
1995	88,306	23,209	250,865	2,570	80,961	445,911
1996	91,887	30,551	205,833	2,636	98,431	429,338
1997	81,065	22,845	293,618	2,838	83,755	484,121
1998	81,077	27,506	328,241	2,806	102,613	542,243
1999	71,023	26,787	275,091	3,162	102,060	478,123
2000	96,908	26,957	276,615	3,343	109,665	513,488
2001	95,569	24,443	289,725	3,716	98,058	511,511
2002	95,644	24,133	268,839	3,172	105,188	496,976
2003	95,712	24,304	325,493	3,101	122,658	571,268
2004	104,066	30,640	323,660	2,706	139,483	600,555
2005	87,417	27,007	357,404	2,508	83,162	557,498
2006	85,016	23,653	343,410	2,607	91,132	545,818
2007	82,516	26,570	353,141	2,854	106,540	571,621
2008	84,200	22,705	431,317	2,903	106,666	647,791
2009	99,373	23,918	334,666	3,027	101,374	562,358
2010	98,523	20,112	351,311	3,611	96,710	570,267
2011	97,778	36,838	315,212	3,802	83,529	537,159
2012	87,666	34,705	398,182	3,935	103,389	627,877
2013	77,346	21,924	372,649	2,460	108,735	583,114

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Table 5: *(continued)*

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
2014	100,375	24,082	379,904	2,195	115,106	621,662
2015	104,375	35,719	317,558	2,729	136,652	597,033
2016	91,870	23,387	406,661	2,803	139,647	664,368
2017	86,227	24,935	495,648	2,618	101,175	710,603
2018	97,727	26,225	375,902	2,590	196,456	698,900
2019	106,279	17,706	347,587	2,879	219,581	694,032
2020	75,797	30,471	392,598	2,938	225,208	727,012

Table 6: Bigeye tuna catch (metric tonnes) by gear type for the WCPFC-CA, from 1960 to 2020. Note: Data for 2020 are preliminary.

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
1960	43,467	1,500	58	0	0	45,025
1961	37,517	1,800	63	0	0	39,380
1962	35,895	800	173	0	0	36,868
1963	42,540	1,800	6	0	0	44,346
1964	30,989	1,143	231	0	28	32,391
1965	29,848	1,254	201	0	30	31,333
1966	31,984	1,108	9	0	86	33,187
1967	33,632	2,803	62	0	253	36,750
1968	27,757	2,272	194	0	204	30,427
1969	32,571	3,350	49	0	62	36,032
1970	34,965	3,178	591	0	2,968	41,702
1971	38,359	1,862	678	0	3,243	44,142
1972	51,040	1,762	671	0	3,690	57,163
1973	42,412	1,258	770	0	4,449	48,889
1974	45,653	1,039	1,079	0	4,987	52,758
1975	61,488	1,334	1,280	0	5,212	69,314
1976	73,325	3,423	2,008	0	4,354	83,110
1977	72,083	3,325	2,693	0	5,954	84,055
1978	56,364	3,337	2,932	0	4,331	66,964
1979	63,837	2,540	3,214	0	4,966	74,557
1980	62,537	2,916	3,816	0	4,086	73,355
1981	46,590	3,382	11,756	0	4,624	66,352
1982	48,578	4,993	19,017	0	4,142	76,730
1983	46,311	5,077	26,764	0	4,704	82,856
1984	52,976	4,557	27,068	0	5,047	89,648
1985	58,629	5,529	20,175	0	6,175	90,508
1986	56,989	4,133	42,895	0	6,346	110,363
1987	68,832	4,602	34,993	0	5,552	113,979
1988	68,288	5,890	29,255	0	6,803	110,236
1989	64,916	6,131	32,473	0	7,447	110,967
1990	77,009	5,985	43,260	0	8,122	134,376
1991	61,033	3,929	45,577	0	9,347	119,886
1992	75,966	4,055	56,923	0	6,201	143,145
1993	66,566	4,505	44,902	0	5,670	121,643
1994	79,175	5,251	43,224	0	7,823	135,473
1995	68,125	6,228	36,918	145	8,265	119,681
1996	58,054	7,940	38,923	432	9,924	115,273
1997	68,597	6,563	58,009	412	7,518	141,099
1998	85,048	6,405	60,638	507	9,043	161,641
1999	74,959	5,856	80,572	316	8,747	170,450
2000	76,924	6,838	66,280	397	10,003	160,442
2001	78,690	5,905	53,500	408	9,032	147,535
2002	92,381	6,109	60,976	713	9,273	169,452
2003	83,016	5,296	57,564	142	11,240	157,258
2004	99,709	9,238	73,313	232	12,560	195,052
2005	78,892	6,851	71,703	220	5,523	163,189
2006	83,592	9,781	71,643	157	6,264	171,437
2007	81,113	7,296	75,242	187	6,915	170,753
2008	83,428	9,204	79,869	212	6,214	178,927
2009	80,507	7,916	81,151	175	5,216	174,965
2010	72,721	7,027	64,494	275	4,049	148,566
2011	77,567	5,655	87,302	251	5,600	176,375
2012	83,971	3,934	76,634	273	12,819	177,631
2013	65,637	5,009	84,404	271	12,002	167,323

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Table 6: *(continued)*

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
2014	75,434	4,714	81,430	312	15,011	176,901
2015	73,397	5,687	60,970	204	14,750	155,008
2016	63,077	3,933	73,957	201	21,368	162,536
2017	58,126	2,264	66,767	184	11,088	138,429
2018	68,911	4,165	74,282	135	11,211	158,704
2019	69,425	1,514	50,728	173	14,671	136,511
2020	60,762	1,206	73,243	203	21,225	156,639

Table 7: Albacore tuna catch (metric tonnes) by gear type for the WCPFC-CA (including the overlap region with the IATTC), south of the equator, from 1960 to 2020. Note: Data for 2020 are preliminary.

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
1960	18,750	0	0	0	0	18,750
1961	19,979	0	0	0	0	19,979
1962	24,492	0	0	0	0	24,492
1963	16,827	0	0	0	0	16,827
1964	13,058	0	0	0	0	13,058
1965	18,057	0	0	0	0	18,057
1966	31,786	0	0	0	0	31,786
1967	35,292	0	0	5	0	35,297
1968	27,332	0	0	14	0	27,346
1969	24,024	0	0	0	0	24,024
1970	33,285	100	0	50	0	33,435
1971	34,116	100	0	0	0	34,216
1972	33,079	100	0	268	0	33,447
1973	44,734	100	0	484	0	45,318
1974	26,279	100	0	898	0	27,277
1975	18,498	100	0	646	0	19,244
1976	28,024	100	0	25	0	28,149
1977	32,979	100	0	621	0	33,700
1978	29,944	100	0	1,686	0	31,730
1979	24,180	100	0	814	0	25,094
1980	29,072	100	0	1,468	0	30,640
1981	30,265	0	0	2,085	5	32,355
1982	27,499	0	0	2,434	6	29,939
1983	23,559	0	0	744	39	24,342
1984	18,541	0	0	2,773	1,589	22,903
1985	23,413	0	0	3,253	1,937	28,603
1986	28,765	0	0	2,003	1,946	32,714
1987	19,750	0	0	2,134	930	22,814
1988	27,617	0	0	4,061	5,283	36,961
1989	17,887	0	0	8,135	21,968	47,990
1990	17,671	245	0	6,740	7,538	32,194
1991	20,303	14	0	7,570	1,489	29,376
1992	28,069	11	0	6,343	65	34,488
1993	27,229	62	0	4,061	70	31,422
1994	31,673	65	0	6,929	89	38,756
1995	26,036	139	0	7,481	104	33,760
1996	24,301	30	0	7,274	156	31,761
1997	31,449	9	0	4,530	133	36,121
1998	41,732	9	0	6,113	85	47,939
1999	28,788	38	0	3,194	74	32,094
2000	34,440	80	0	6,104	139	40,763
2001	54,018	19	0	5,047	199	59,283
2002	63,598	7	0	4,517	150	68,272
2003	52,098	5	0	5,984	130	58,217
2004	49,960	6	0	4,551	123	54,640
2005	53,917	12	0	3,431	137	57,497
2006	55,923	23	0	2,749	188	58,883
2007	52,847	17	0	1,987	60	54,911
2008	54,200	12	0	3,502	160	57,874
2009	72,813	21	0	2,031	211	75,076
2010	78,643	14	0	2,139	190	80,986
2011	55,275	21	0	3,189	233	58,718
2012	71,814	26	0	2,962	248	75,050
2013	72,091	26	0	3,226	248	75,591

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Table 7: *(continued)*

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
2014	61,494	26	0	2,403	248	64,171
2015	62,089	24	0	2,602	263	64,978
2016	58,510	33	10	2,158	333	61,044
2017	75,671	12	10	2,424	199	78,316
2018	65,388	16	17	2,702	380	68,503
2019	67,428	43	2	2,779	263	70,515
2020	59,750	24	4	4,753	331	64,862

Table 8: Albacore tuna catch (metric tonnes) by gear type for the eastern Pacific region (excluding the overlap region with the IATTC), south of the equator, from 1960 to 2020. Note: Data for 2020 are preliminary.

Year	**Longline**	**Pole-and-line**	**Purse seine**	**Troll**	**Other**	**Total**
1960	3,498	45	0	0	0	3,543
1961	3,763	0	0	0	0	3,763
1962	10,727	0	0	0	0	10,727
1963	14,268	16	0	0	0	14,284
1964	9,766	0	0	0	0	9,766
1965	7,398	0	0	0	0	7,398
1966	6,875	0	0	0	0	6,875
1967	8,660	0	0	0	0	8,660
1968	5,036	0	0	0	0	5,036
1969	781	0	0	0	0	781
1970	1,490	0	0	0	0	1,490
1971	4,414	0	0	0	0	4,414
1972	6,052	22	0	0	0	6,074
1973	1,971	41	0	0	0	2,012
1974	6,760	12	0	0	0	6,772
1975	4,351	5	0	0	0	4,356
1976	933	0	0	0	0	933
1977	5,040	0	0	0	0	5,040
1978	2,946	0	0	0	0	2,946
1979	1,982	0	0	0	0	1,982
1980	1,900	1	0	0	0	1,901
1981	2,429	0	0	0	0	2,429
1982	848	1	0	0	0	849
1983	750	0	0	0	0	750
1984	1,799	2	0	0	0	1,801
1985	3,725	0	0	0	0	3,725
1986	3,876	0	0	0	0	3,876
1987	2,229	9	0	0	0	2,238
1988	671	0	0	235	0	906
1989	851	0	0	235	0	1,086
1990	3,633	0	0	235	0	3,868
1991	5,989	0	0	235	0	6,224
1992	3,945	0	0	235	0	4,180
1993	3,769	12	0	235	0	4,016
1994	3,325	2	0	235	0	3,562
1995	4,472	0	0	243	0	4,715
1996	2,462	0	0	179	0	2,641
1997	3,208	12	0	149	0	3,369
1998	2,420	27	0	189	0	2,636
1999	7,171	100	0	309	0	7,580
2000	6,990	22	0	686	0	7,698
2001	3,981	18	0	408	0	4,407
2002	6,681	11	0	310	0	7,002
2003	5,225	7	0	688	0	5,920
2004	8,331	104	0	439	0	8,874
2005	7,079	17	0	161	0	7,257
2006	6,294	6	0	256	0	6,556
2007	4,379	0	0	80	0	4,459
2008	5,629	0	0	0	0	5,629
2009	9,338	0	0	0	0	9,338
2010	9,863	0	0	0	0	9,863
2011	7,738	9	0	0	0	7,747
2012	14,819	15	0	0	0	14,834
2013	12,391	0	0	0	0	12,391

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Table 8: *(continued)*

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
2014	18,650	0	0	21	0	18,671
2015	18,631	0	0	0	0	18,631
2016	11,471	7	0	0	0	11,468
2017	16,196	2	0	0	0	16,188
2018	14,873	0	0	0	0	14,856
2019	15,570	0	0	0	0	15,568
2020	7,077	0	0	14	0	7,087

Table 9: Albacore tuna catch (metric tonnes) by gear type for the WCPFC-CA, north of the equator, from 1960 to 2020. Note: Data for 2020 are preliminary.

Year	Longline	Pole-and-line	Purse seine	Troll	Other	Total
1960	12,637	25,156	0	0	76	37,869
1961	12,668	18,639	7	0	268	31,582
1962	12,866	8,729	53	0	191	21,839
1963	10,151	26,420	59	0	218	36,848
1964	13,182	23,858	128	0	319	37,487
1965	10,546	41,491	11	0	121	52,169
1966	19,802	22,830	111	0	585	43,328
1967	22,916	30,481	89	0	520	54,006
1968	18,895	16,597	267	0	1,109	36,868
1969	14,454	32,148	521	0	959	48,082
1970	15,696	24,385	317	0	517	40,915
1971	11,909	53,351	902	0	359	66,521
1972	14,695	60,591	277	0	645	76,208
1973	15,101	68,808	1,353	0	569	85,831
1974	13,020	73,576	161	0	1,128	87,885
1975	12,682	52,157	159	0	409	65,407
1976	16,998	85,336	1,109	0	1,355	104,798
1977	15,810	31,934	669	0	1,058	49,471
1978	12,316	59,877	1,115	0	6,123	79,431
1979	12,115	44,662	125	0	4,011	60,913
1980	13,271	46,743	329	0	4,179	64,522
1981	17,007	27,426	252	0	11,071	55,756
1982	16,377	29,615	561	0	13,117	59,670
1983	13,225	21,098	350	0	7,206	41,879
1984	12,737	26,015	3,380	0	10,022	52,154
1985	14,599	20,714	1,533	0	12,187	49,033
1986	12,937	16,096	1,542	0	9,194	39,769
1987	13,649	19,091	1,205	0	10,218	44,163
1988	14,077	6,216	1,208	235	17,656	39,392
1989	12,260	8,629	2,521	235	17,276	40,921
1990	14,499	8,532	1,995	235	24,034	49,295
1991	15,156	7,103	2,652	235	8,050	33,196
1992	17,482	13,888	4,104	235	12,392	48,101
1993	28,954	12,809	2,889	235	1,187	46,074
1994	27,956	26,391	2,026	235	1,097	57,705
1995	34,352	20,981	1,177	1,091	389	57,990
1996	37,289	20,272	581	951	286	59,379
1997	41,194	32,250	1,068	1,734	534	76,780
1998	38,310	22,953	1,554	1,357	352	64,526
1999	40,046	50,469	6,872	1,144	441	98,972
2000	35,643	21,572	2,408	996	289	60,908
2001	31,004	29,448	974	622	230	62,278
2002	26,556	48,465	3,303	931	526	79,781
2003	26,986	36,121	627	927	360	65,021
2004	27,063	32,359	7,200	838	299	67,759
2005	29,388	16,150	850	743	654	47,785
2006	29,596	15,406	364	596	412	46,374
2007	27,480	37,768	5,682	549	394	71,873
2008	25,124	19,060	825	550	1,675	47,234
2009	26,462	31,172	2,076	413	423	60,546
2010	27,499	19,561	330	590	258	48,238
2011	30,013	25,713	480	449	326	56,981
2012	29,598	33,757	4,193	613	581	68,742
2013	27,215	33,576	1,988	304	432	63,515

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Table 9: *(continued)*

Year	**Longline**	**Pole-and-line**	**Purse seine**	**Troll**	**Other**	**Total**
2014	26,114	29,433	2,009	200	406	58,162
2015	29,849	21,294	1,072	241	512	52,968
2016	21,627	14,442	3,679	149	324	40,221
2017	23,730	20,893	2,646	497	465	48,231
2018	21,062	17,914	3,001	90	341	42,408
2019	23,313	17,914	3,098	80	813	45,218
2020	18,721	17,914	3,374	97	607	40,713

Table 10: Biological Reference Points (BRPs) and stock status from the latest stock assessments (assessment year shown in parentheses) for South Pacific albacore, bigeye, skipjack, and yellowfin tunas. All biomasses are in metric tonnes. SB_{recent} is the average spawning biomass over the last 4 years of the assessment; $SB_{F=0}$ is the average spawning biomass (over the recent 10-year period) predicted to occur in the absence of fishing; MSY is the maximum sustainable yield based on recent patterns of fishing; F_{recent}/F_{MSY} is the ratio of recent (using a window one year earlier than for SB) fishing mortality to that which will support the MSY; $SB_{recent}/SB_{F=0}$ spawning biomass in the recent time period (last 4 years of the assessment) relative to that predicted to occur in the absence of fishing.

BRP	**Albacore (2021)**	**Bigeye (2020)**	**Skipjack (2019)**	**Yellowfin (2020)**
SB_{recent}	352,739	590,311	2,576,701	1,994,655
$SB_{F=0}$	678,345	1,353,367	6,299,363	3,603,980
MSY	120,020	140,720	2,294,024	1,091,200
F_{recent}/F_{MSY}	0.24	0.72	0.45	0.36
$SB_{recent}/SB_{F=0}$	0.52	0.41	0.44	0.58

Table 11: Total numbers of bigeye, skipjack, and yellowfin tuna tagged during the three major tropical tuna tagging projects in the western and central Pacific region. Note: Separate EEZ results are provided for any region with more than 10,000 releases in any single programme; SSAP = Skipjack Survey and Assessment Programme (1977-1981); RTTP = Regional Tuna Tagging Programme (1989-1992); PTTP = Pacific Tuna Tagging Programme (2006-2020).

	PTTP		RTTP		SSAP	
EEZ	**Releases**	**Recoveries**	**Releases**	**Recoveries**	**Releases**	**Recoveries**
FJ		9	5,197	528	28,980	2,659
FM	32,844	2,914	11,711	1,779	8,791	330
ID	40,416	6,633	13,740	2,653		37
IW	28,850	4,409				
KI	45,723	5,102	14,754	851	5,212	449
NZ	2,863	9		2	15,020	1,000
PF	0	1		1	29,693	128
PG	218,465	31,292	44,502	3,677	9,079	1,077
PW	14,369	276	7,495	142	8,663	114
SB	78,235	13,979	15,226	2,372	7,870	597
Other	5,343	17,902	39,042	6,925	48,976	1,077
TOTAL	467,108	82,526	151,667	18,930	162,284	7,468

EEZ abbreviations: FJ = Fiji, FM = Federated States of Micronesia, ID = Indonesia, IW = International Waters (High Seas), KI = Kiribati, NZ = New Zealand, PF = French Polynesia, PG = Papua New Guinea, PW = Palau, SB = Solomon Islands, Other = Pacific Island countries and territories with low numbers of releases and/or recoveries.

6 Figures

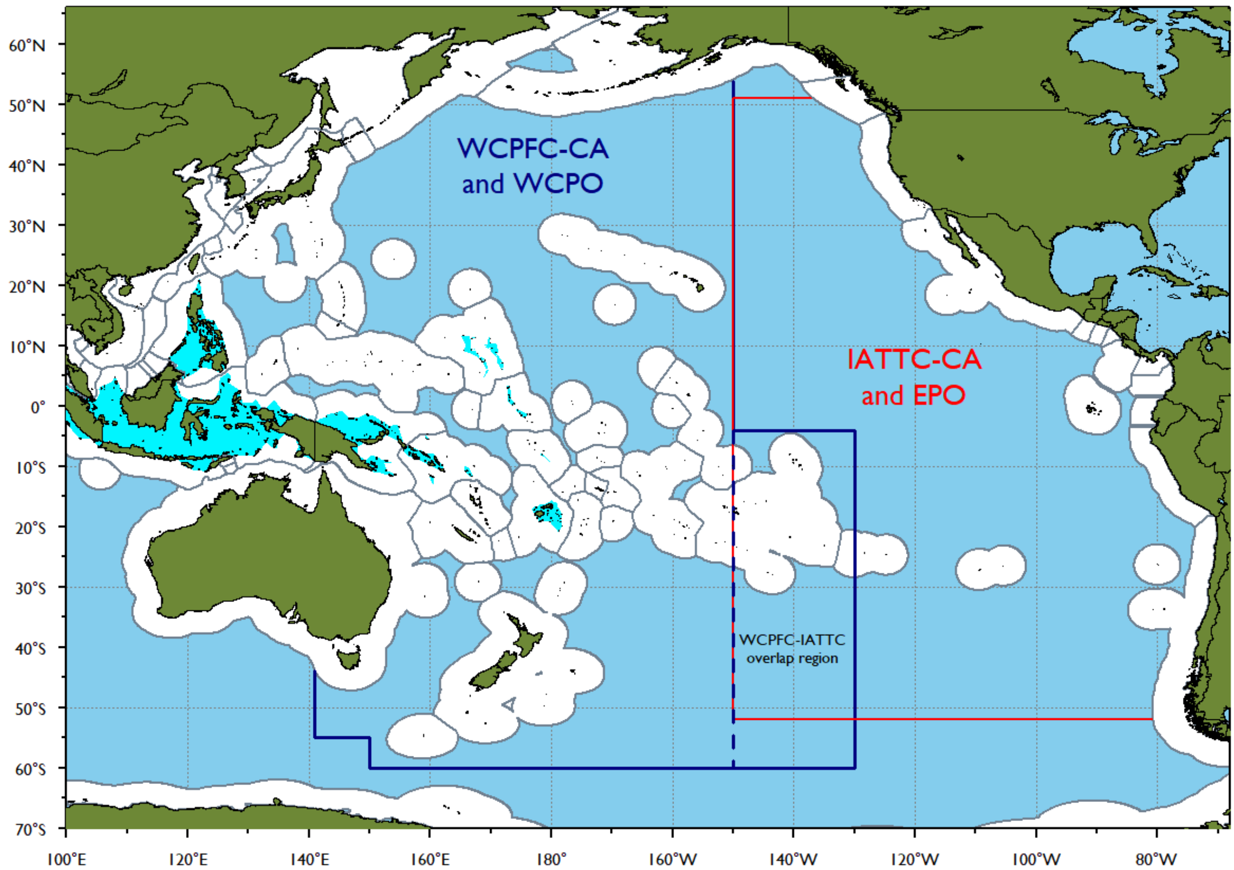
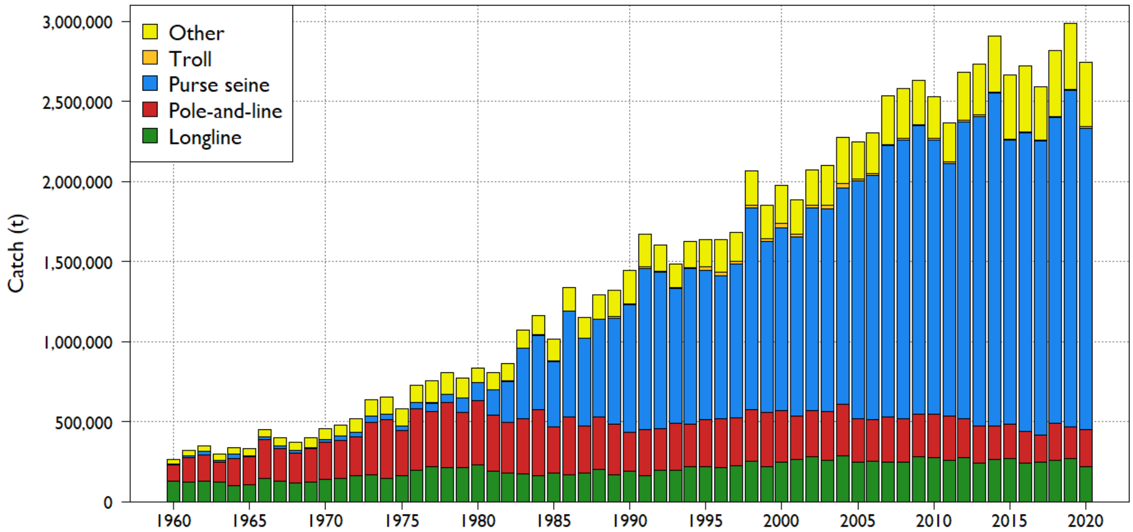


Figure 1: Important national, regional and management zones in the Pacific. The WCPFC Convention Area (WCPFC-CA) is outlined in dark blue, the IATTC Convention Area (IATTC-CA) area is outlined in red. The western and central Pacific Ocean (WCPO) includes all of the WCPFC-CA, minus the overlap with the IATTC-CA; the eastern Pacific Ocean (EPO) is coincident with the IATTC-CA. Pacific nation EEZs are outlined in grey and archipelagic waters are shaded turquoise.



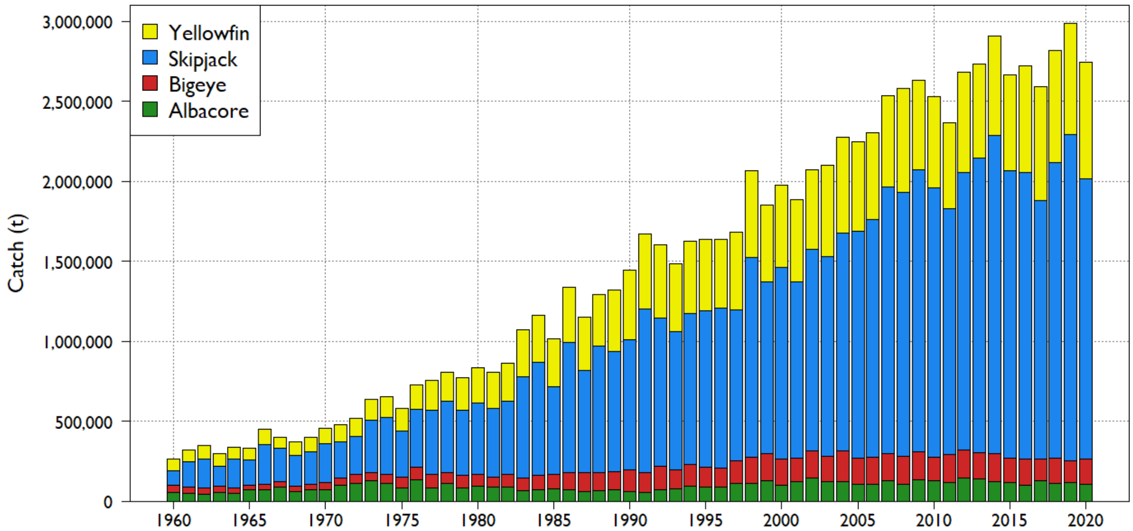
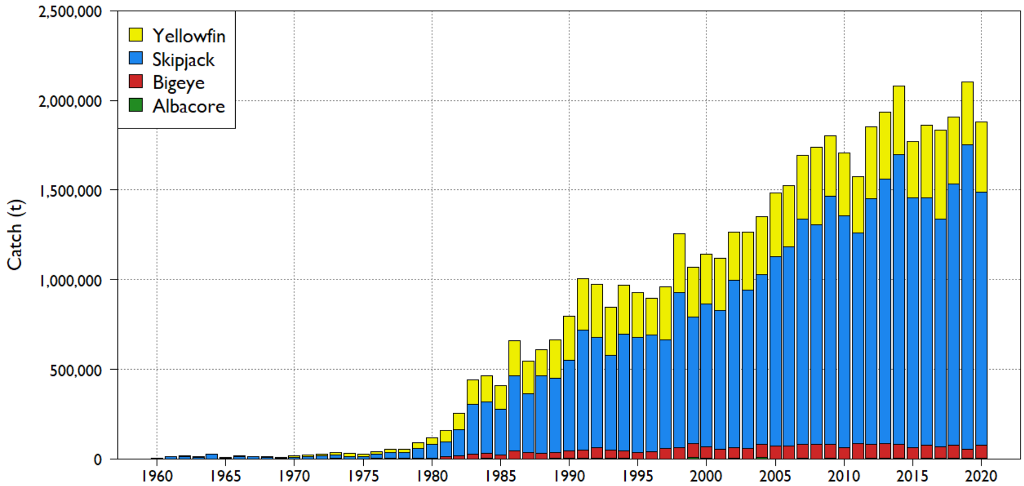
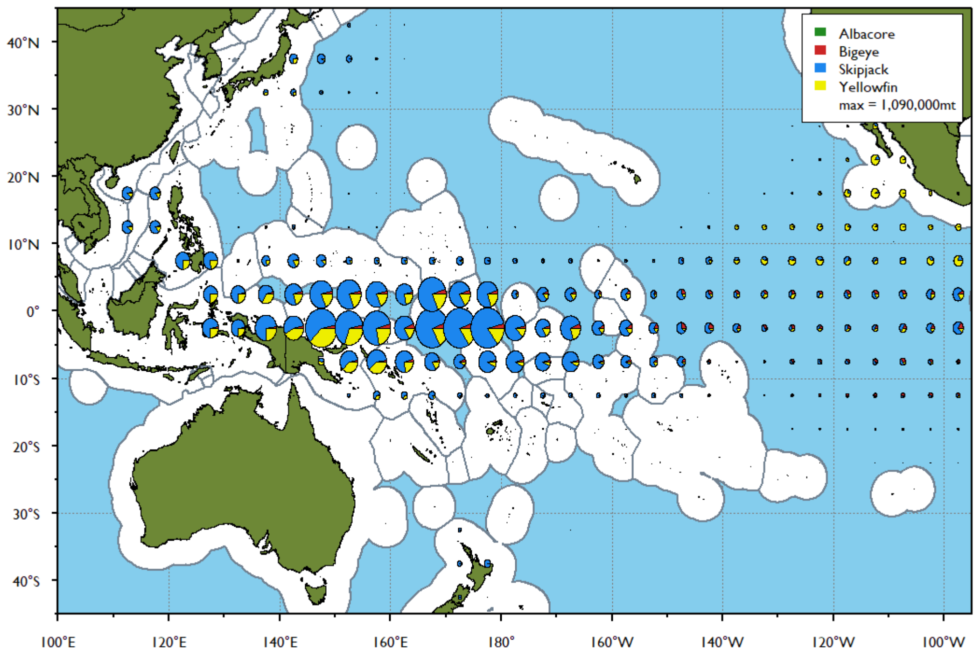


Figure 2: Catch (metric tonnes) by gear (top) and species (bottom) for the western and central Pacific region, 1960–2020. Note: data for 2020 are preliminary.

Purse seine catch and effort plots





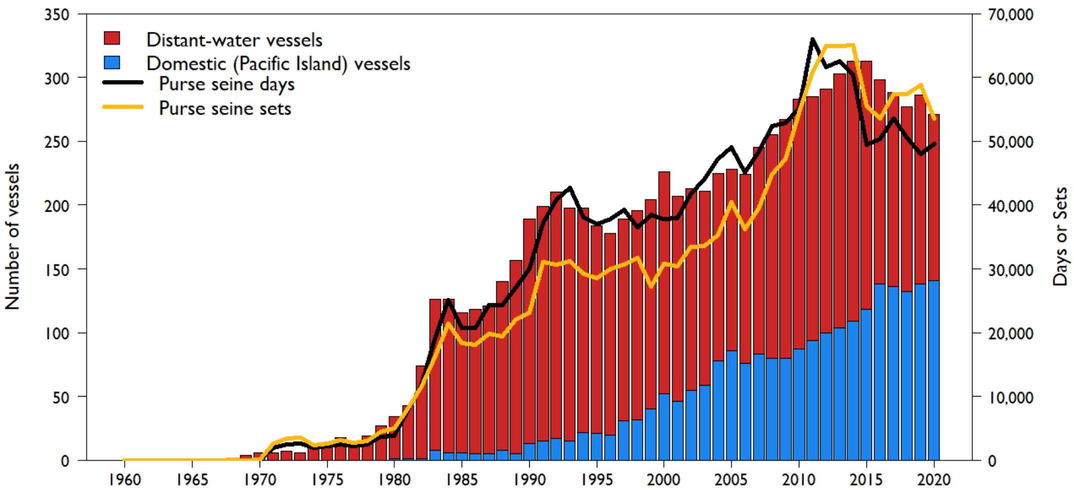


Figure 3: Time series of catch (top), recent (2016–2020) spatial distribution of catch (middle), and indices of fishing effort, in fleet sizes and number of sets and days (bottom), for the purse seine fishery in the WCPO.

Longline catch and effort plots

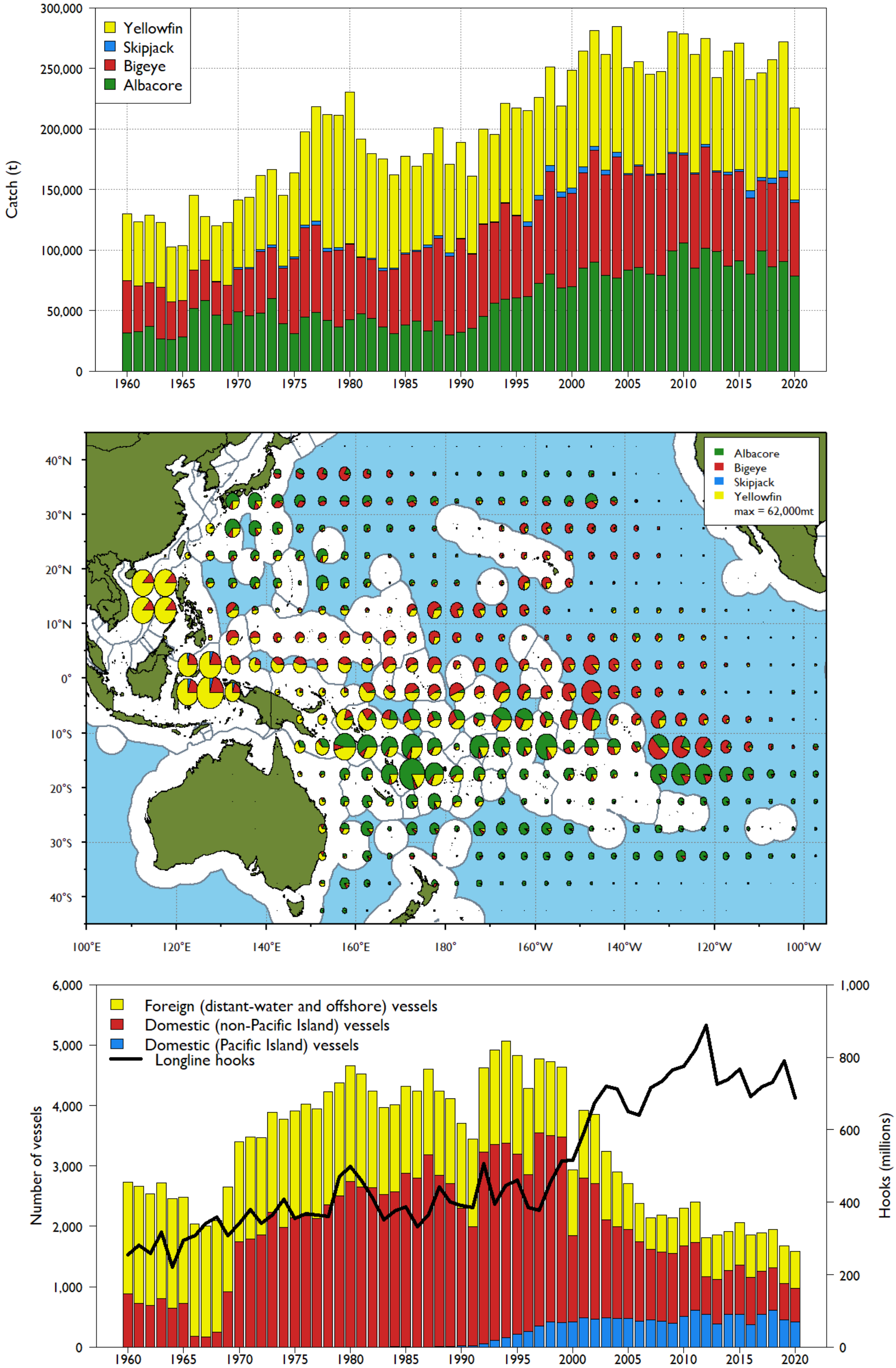


Figure 4: Time series of catch (top), recent (2016–2020) spatial distribution of catch (middle), and indices of fishing effort, in fleet sizes and number of hooks fished (bottom), for the longline fishery in the WCPFC-CA.

Pole-and-line catch and effort plots

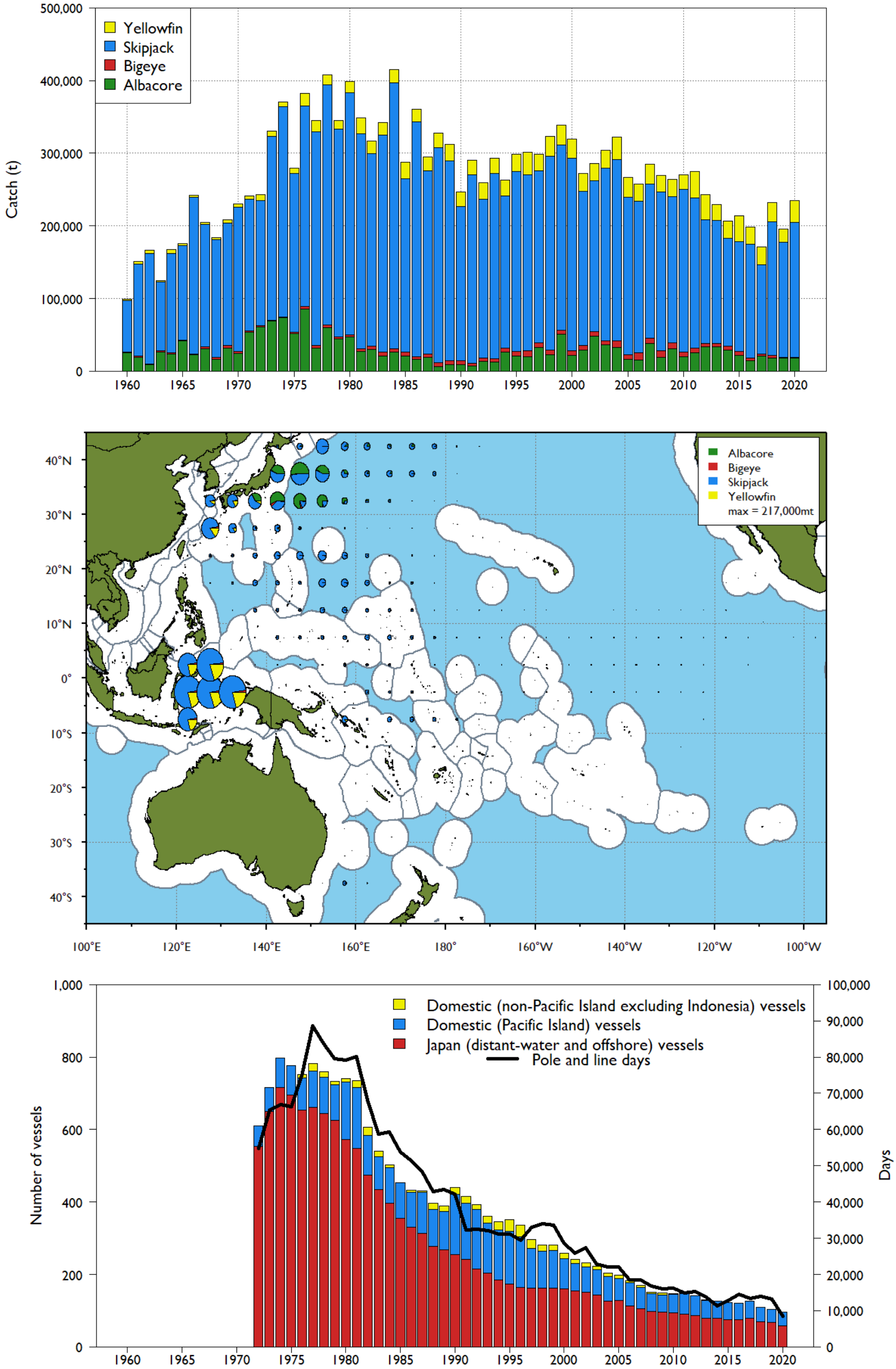


Figure 5: Time series of catch (top), recent (2016–2020) spatial distribution of catch (middle), and indices of fishing effort in fleet sizes and number of days (bottom), for the pole-and-line fishery in the WCPFC-CA. Note that vessel numbers and fishing days are not available prior to 1972.

Skipjack catch data

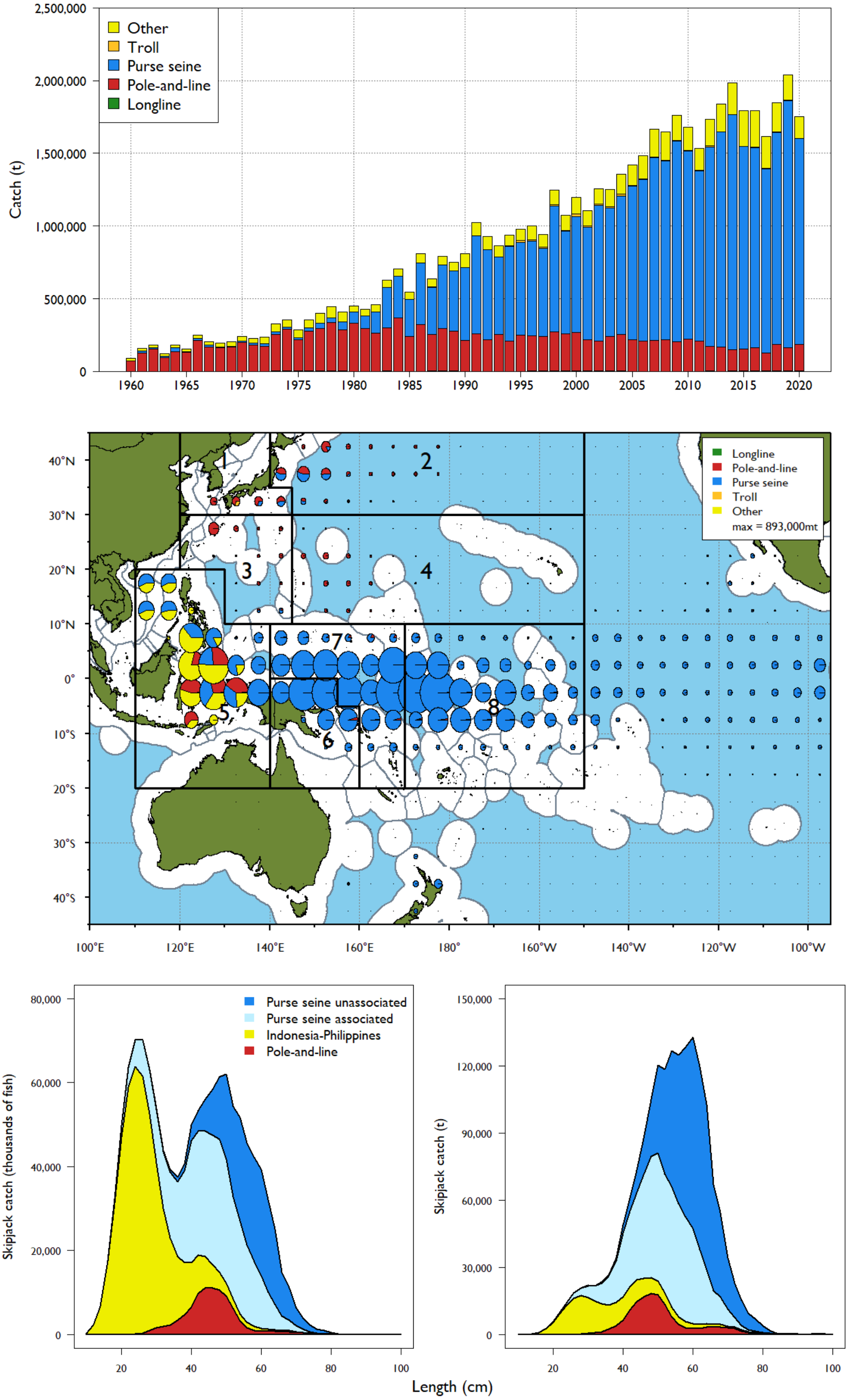


Figure 6: Time series (top), recent (2016–2020) spatial distribution and assessment regions (middle), and size composition (average for last five years, bottom) of skipjack tuna catch by gear for the WCPFC-CA.

Skipjack diagnostic plots

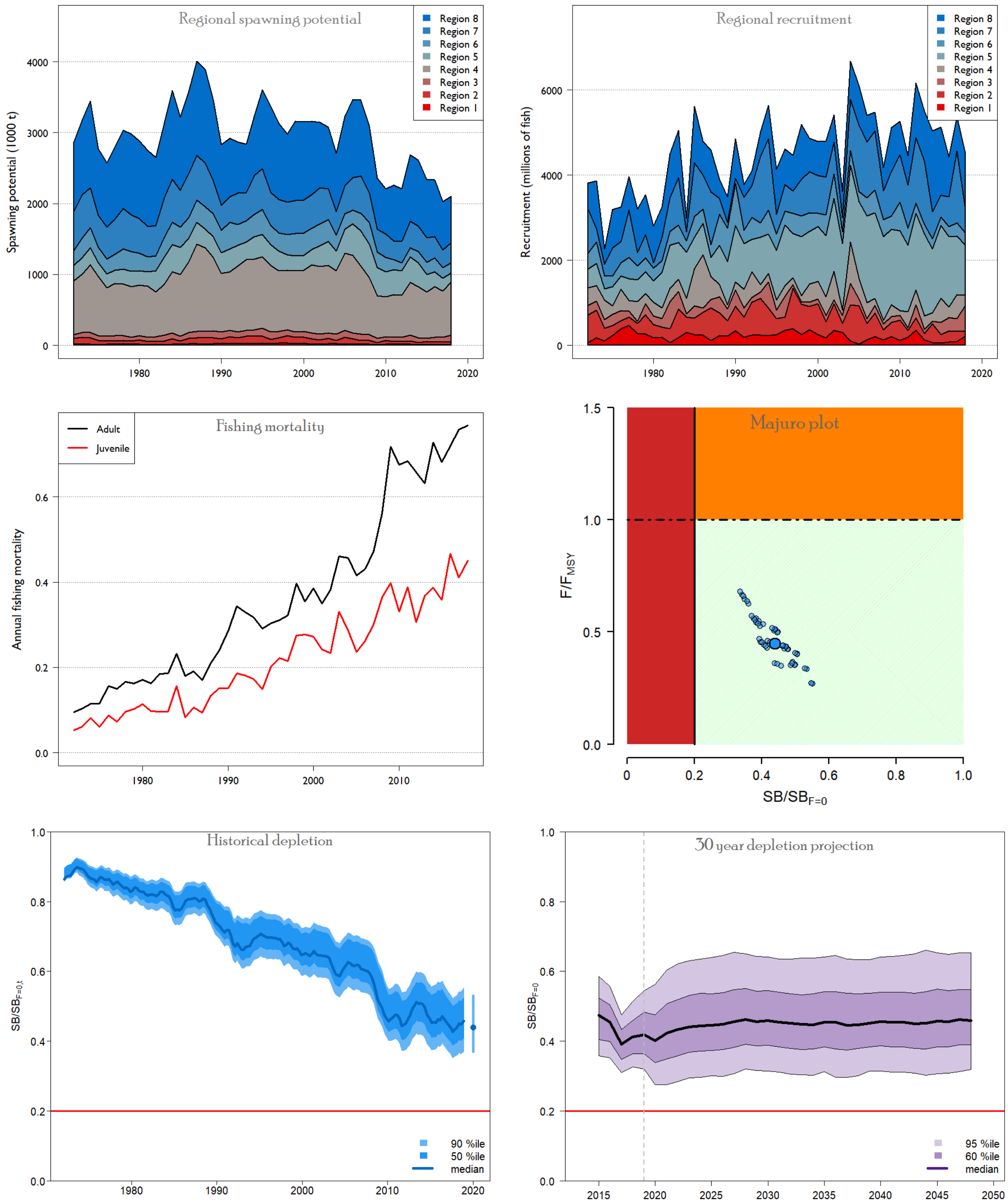


Figure 7: Estimated spawning biomass time series by model region (top left), recruitment by model region (top right), and fishing mortality for adults and juveniles (middle left) from the skipjack diagnostic case model; stock status displayed on a Majuro plot as the end points from the uncertainty grid of 54 models (middle right) with the weighted median value illustrated by the large blue point; the estimated level of depletion across the grid (bottom left), and 30-year projected depletion based on actual fishing levels through 2020, and assumes 2020 fishing levels afterwards (bottom right). Note that depletion is represented differently between the historical and projection plots. Historical depletion is computed instantaneously, i.e. annual spawning biomass divided by annual estimate of spawning biomass in the absence of fishing. For the projections, the spawning biomass in the absence of fishing is computed as a lagged 10-year average in each year.

Yellowfin catch data

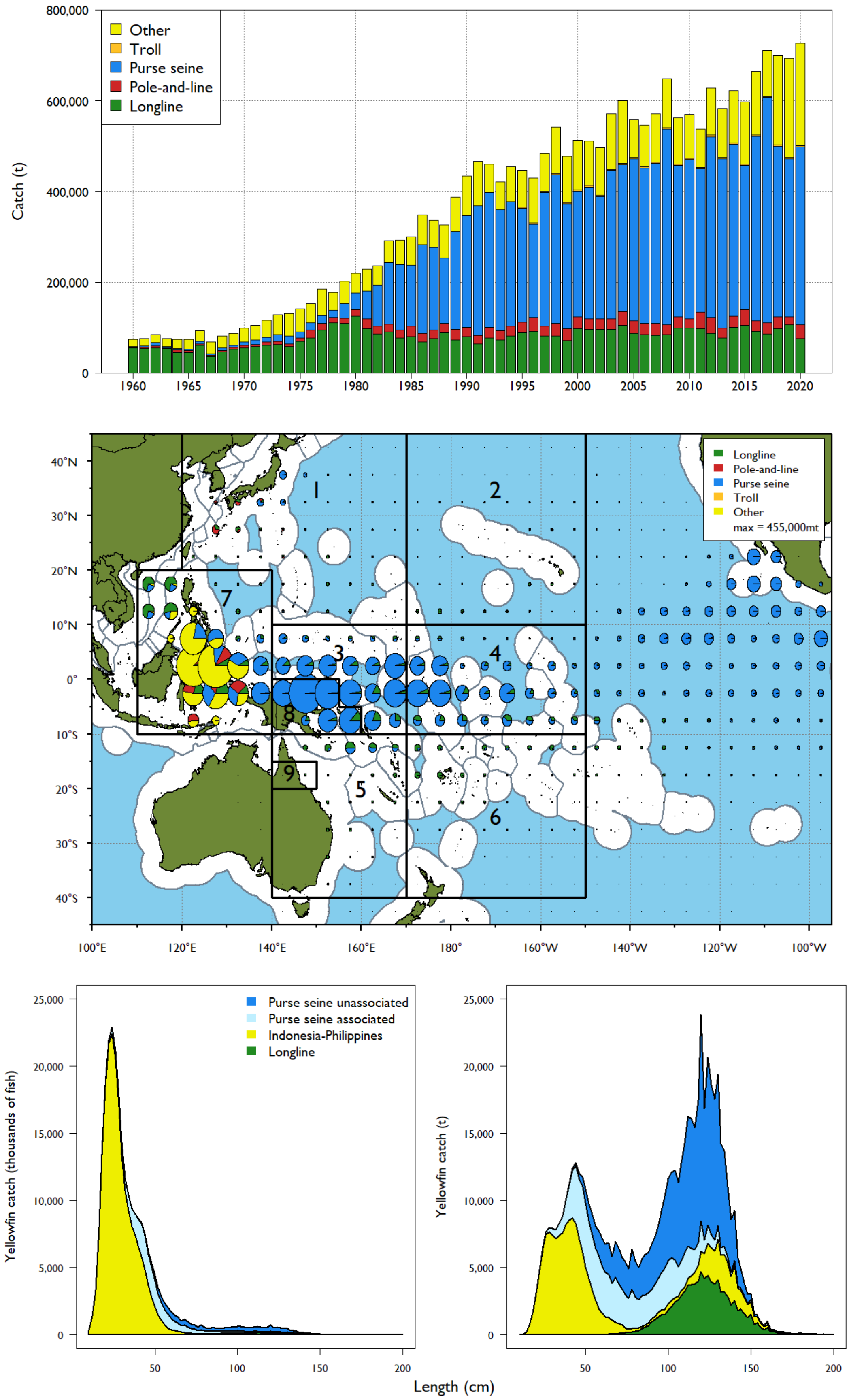


Figure 8: Time series (top), recent (2016–2020) spatial distribution and assessment regions (middle), and size composition (average for last five years, bottom) of yellowfin tuna catch by gear for the WCPFC-CA.

Yellowfin diagnostic plots

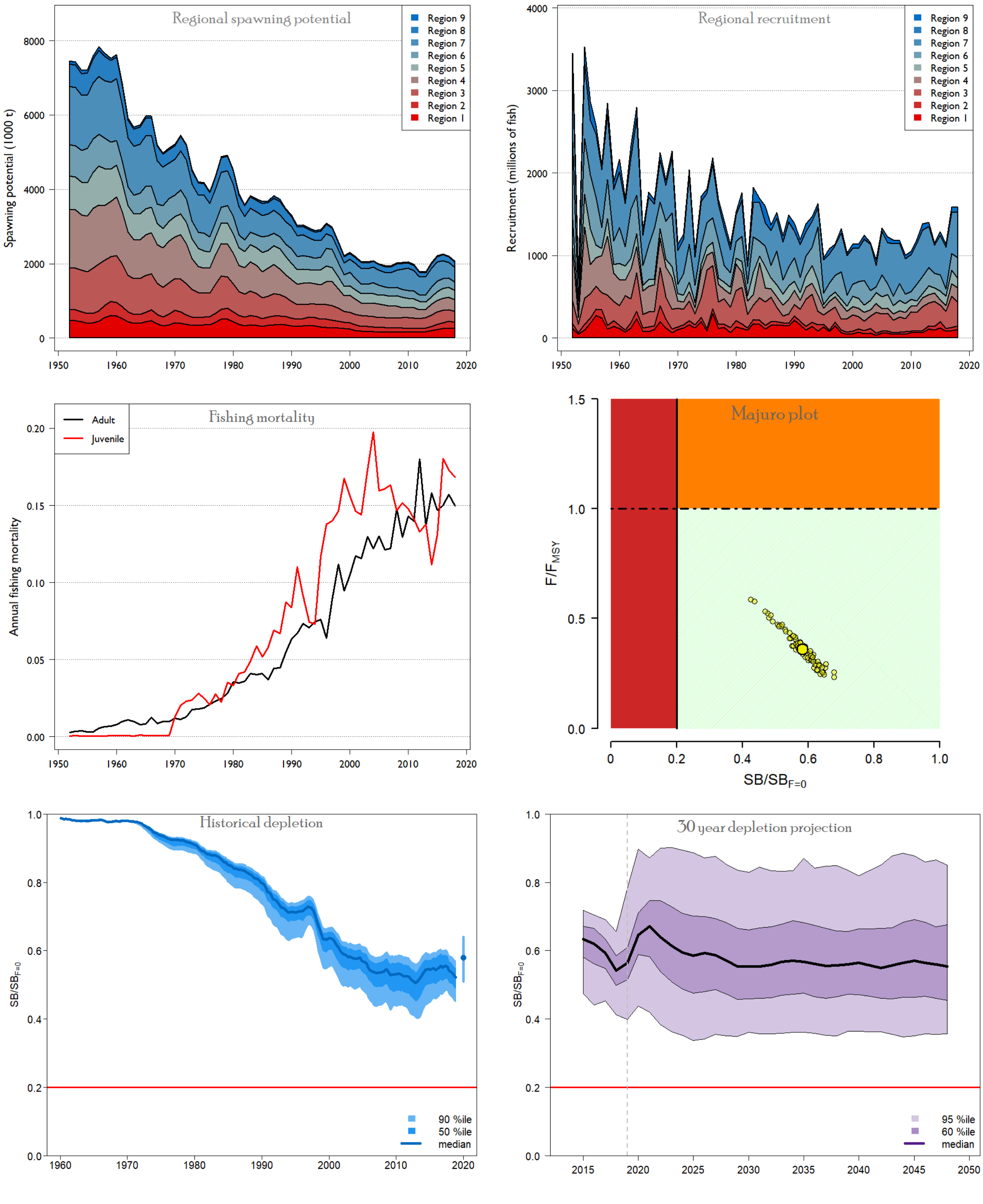


Figure 9: Estimated spawning biomass time series by model region (top left), recruitment by model region (top right), and fishing mortality for adults and juveniles (middle left) from the yellowfin diagnostic case model; stock status displayed on a Majuro Plot as the end points from the uncertainty grid of 72 models (middle right) with the weighted median value illustrated by the large yellow point; the estimated level of depletion across the grid (bottom left), and 30-year projected depletion based on actual catch/effort levels through 2020, and assumes 2020 fishing catch/effort levels afterwards (bottom right). Note that depletion is represented differently between the historical and projection plots. Historical depletion is computed instantaneously, i.e. annual spawning biomass divided by annual estimate of spawning biomass in the absence of fishing. For the projections, the spawning biomass in the absence of fishing is computed as a lagged 10-year average in each year.

Bigeye catch data

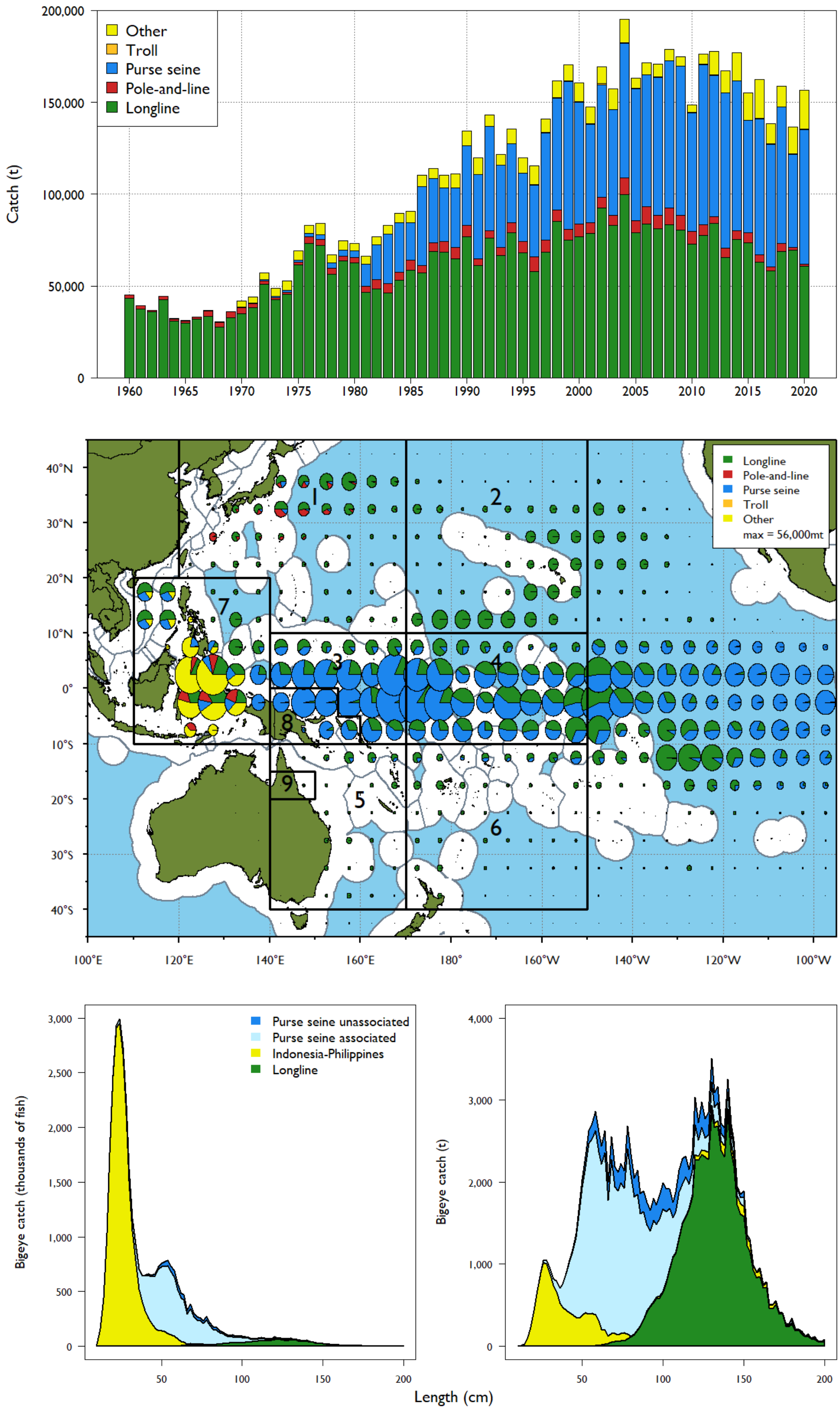


Figure 10: Time series (top), recent (2016–2020) spatial distribution and assessment regions (middle), and size composition (average for last five years, bottom) of bigeye tuna catch by gear for the WCPFC-CA.

Bigeye diagnostic plots

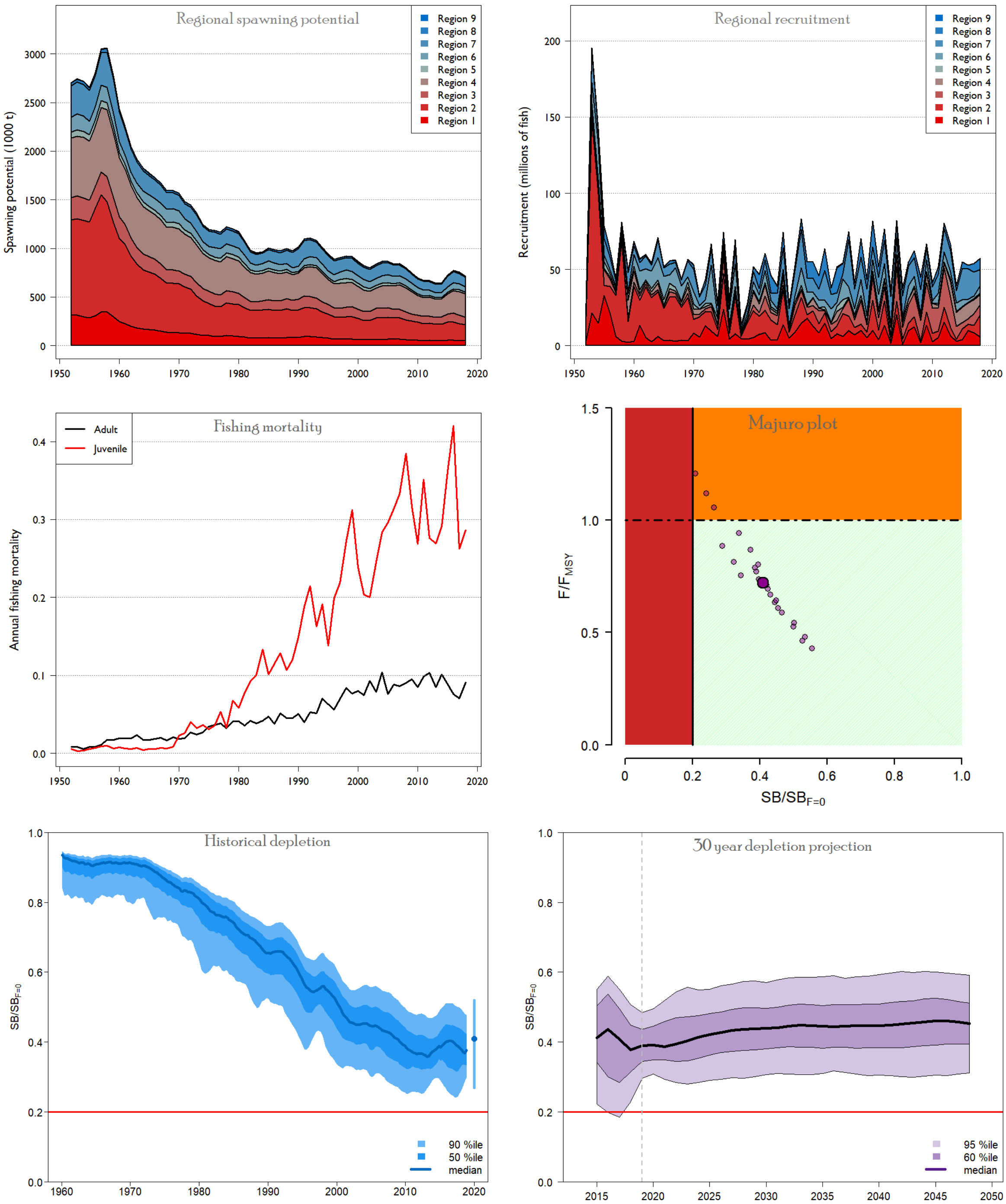


Figure 11: Estimated spawning biomass time series by model region (top left), recruitment by model region (top right), and fishing mortality for adults and juveniles (middle left) from the bigeye diagnostic case model; stock status displayed on a Majuro plot as the end points from the uncertainty grid of 24 models (middle right) with the weighted median value illustrated by the large purple point; the estimated level of depletion across the grid (bottom left), and 30-year projected depletion, under the "recent recruitment" (2007–2016) assumption, based on actual catch/effort levels through 2020, and assumes 2020 fishing catch/effort levels afterwards (bottom right). Note that depletion is represented differently between the historical and projection plots. Historical depletion is computed instantaneously, i.e. annual spawning biomass divided by annual estimate of spawning biomass in the absence of fishing. For the projections, the spawning biomass in the absence of fishing is computed as a lagged 10-year average in each year.

Albacore catch data

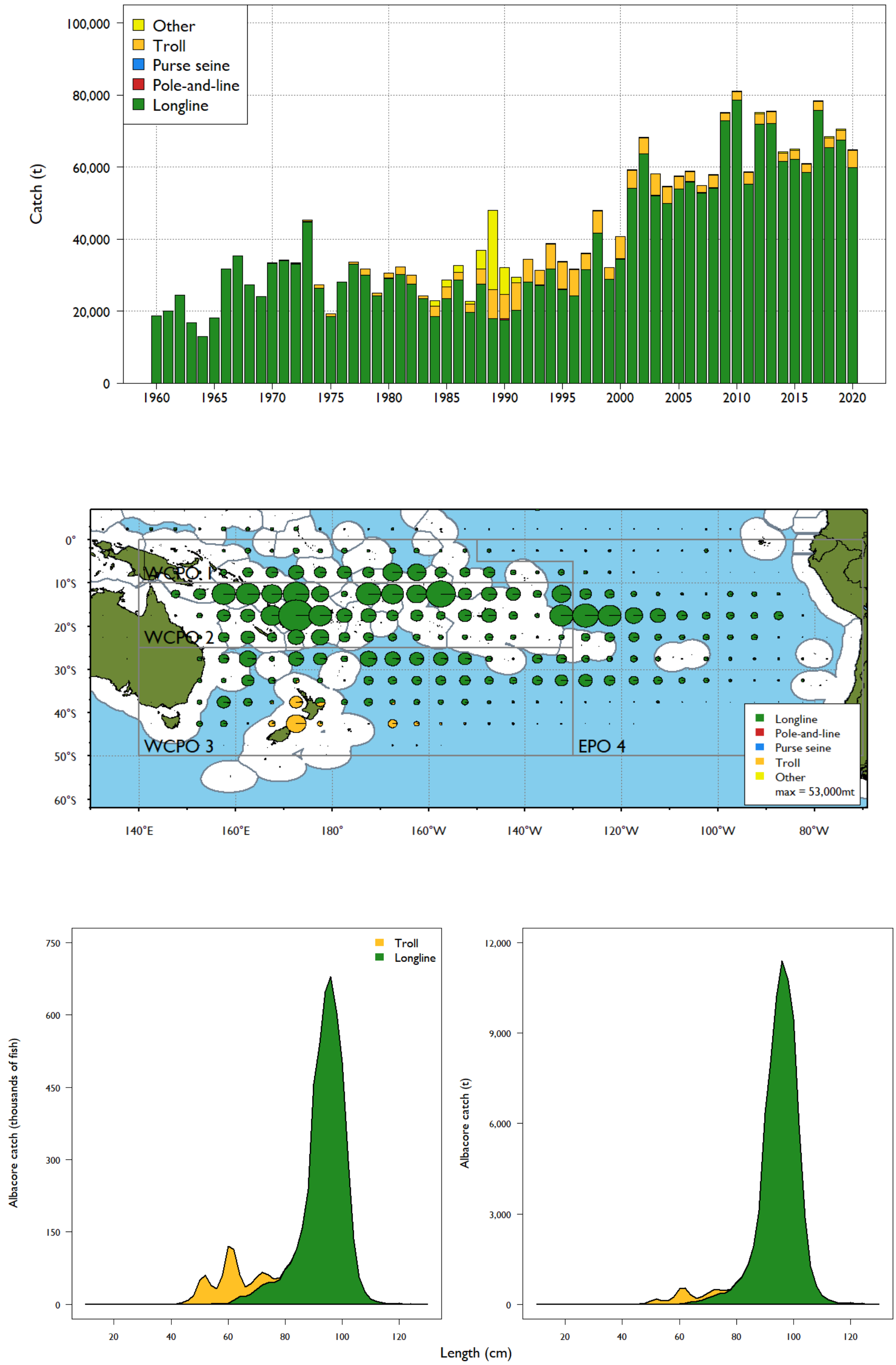


Figure 12: Time series (top), recent (2016–2020) spatial distribution and assessment regions (middle), and size composition (average for last five years, bottom) of South Pacific albacore tuna catch by gear, Pacific-wide, south of the equator. Size data represent only WCPFC-CA-caught albacore.

Albacore diagnostic plots

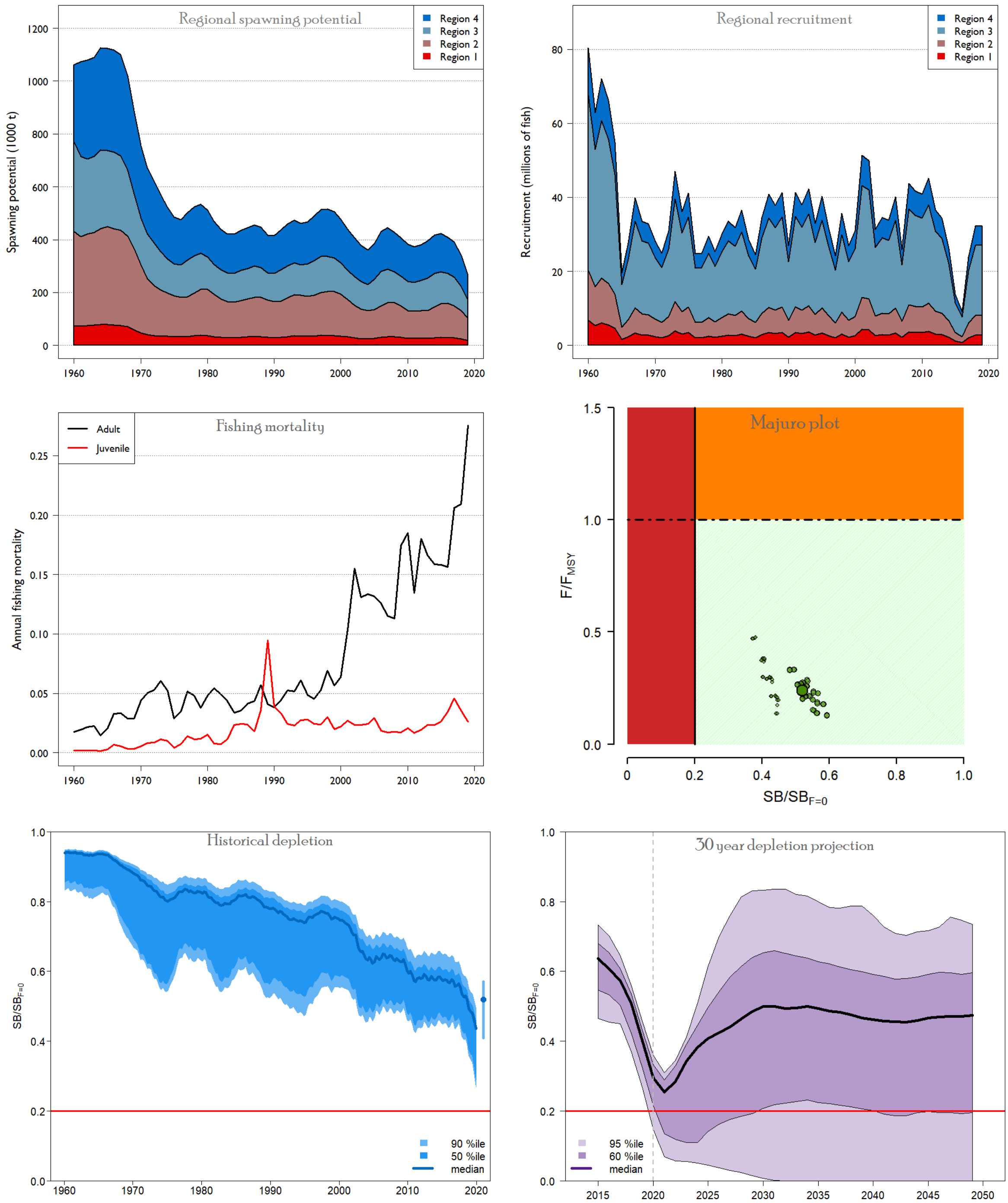


Figure 13: Estimated spawning biomass time series by model region (top left), recruitment by model region (top right), and fishing mortality for adults and juveniles (middle left) from the albacore diagnostic case model; stock status displayed on a Majuro plot as the end points from the uncertainty grid of 72 models (middle right) with the smallest dots indicating the down weighted SEAPODYM movement hypothesis and the single large green point is the weighted median value; the estimated level of depletion across the grid (bottom left), and 30-year projected depletion based on status quo (2020 catch levels) fishing (bottom right). Note that depletion is represented differently between the historical and projection plots. Historical depletion is computed instantaneously, i.e. annual spawning biomass divided by annual estimate of spawning biomass in the absence of fishing. For the projections, the spawning biomass in the absence of fishing is computed as a lagged 10-year average in each year.

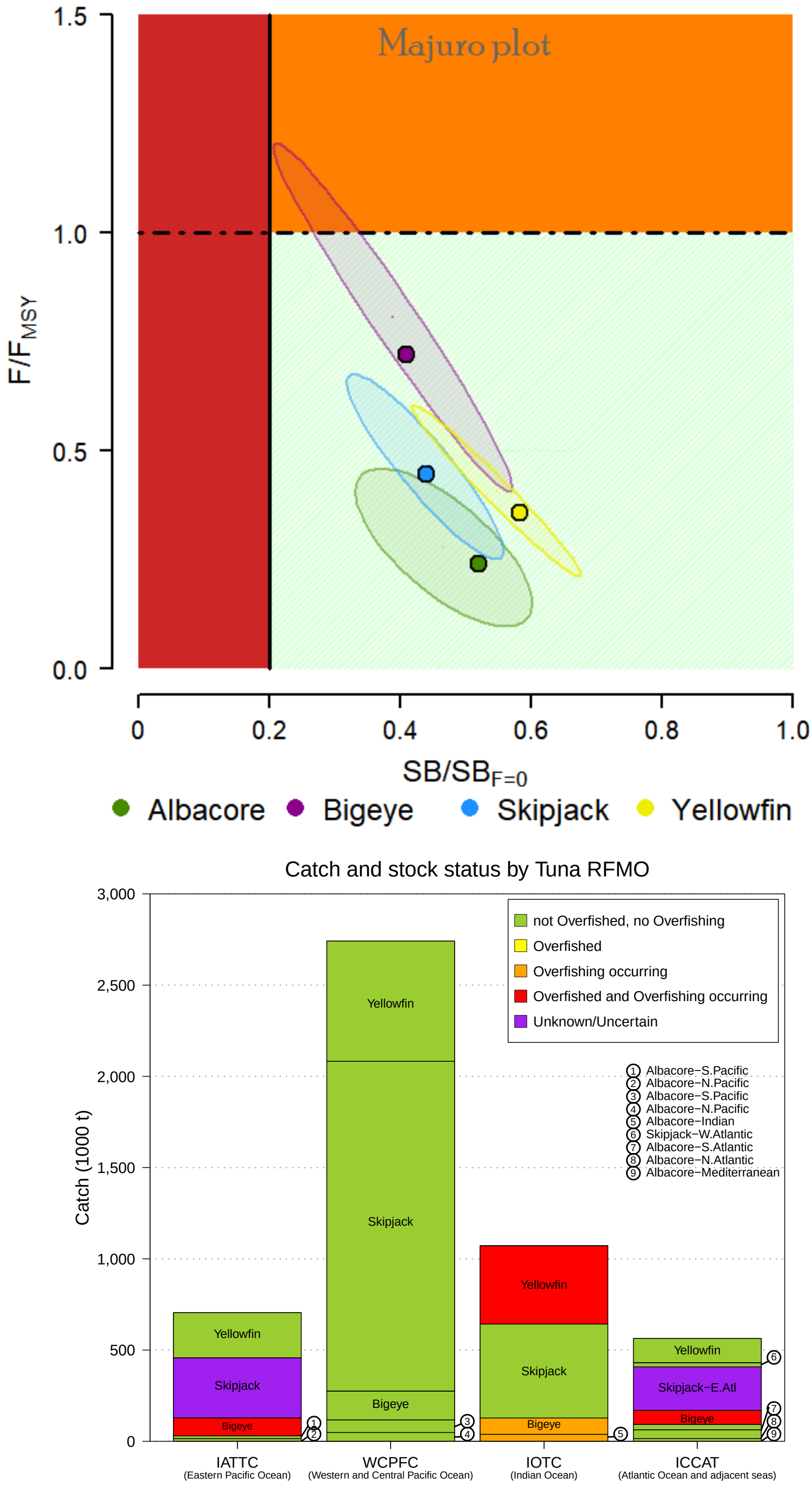


Figure 14: Majuro plot stock status summary for the four WCPO target tuna stocks (top) and a comparison of stock status for the same four tuna species in the other major ocean basins (bottom). In the Majuro plot, the grid median value is shown as a large dot, the ellipses closely approximate the distribution of values from grid models. Readers are referred to the individual species plots in earlier sections for more precise information on stock status from individual models in the uncertainty grid. The stock status comparison across basins is based on spawning biomass and fishing mortality relative to their MSY values. Data are current as of September 2021 and stock status assessments were obtained directly from documents produced by the responsible tuna RFMO. Catch is average catch over the five most recent years available. The "Unknown/Uncertain" classification was used when the reliability of the reference points was stated to be uncertain or unreliable. Note that South and North Pacific albacore are co-managed in the Pacific by both WCPFC and the IATTC and are, therefore, included for both organisations, with the catch levels reflecting the split between the two convention areas.

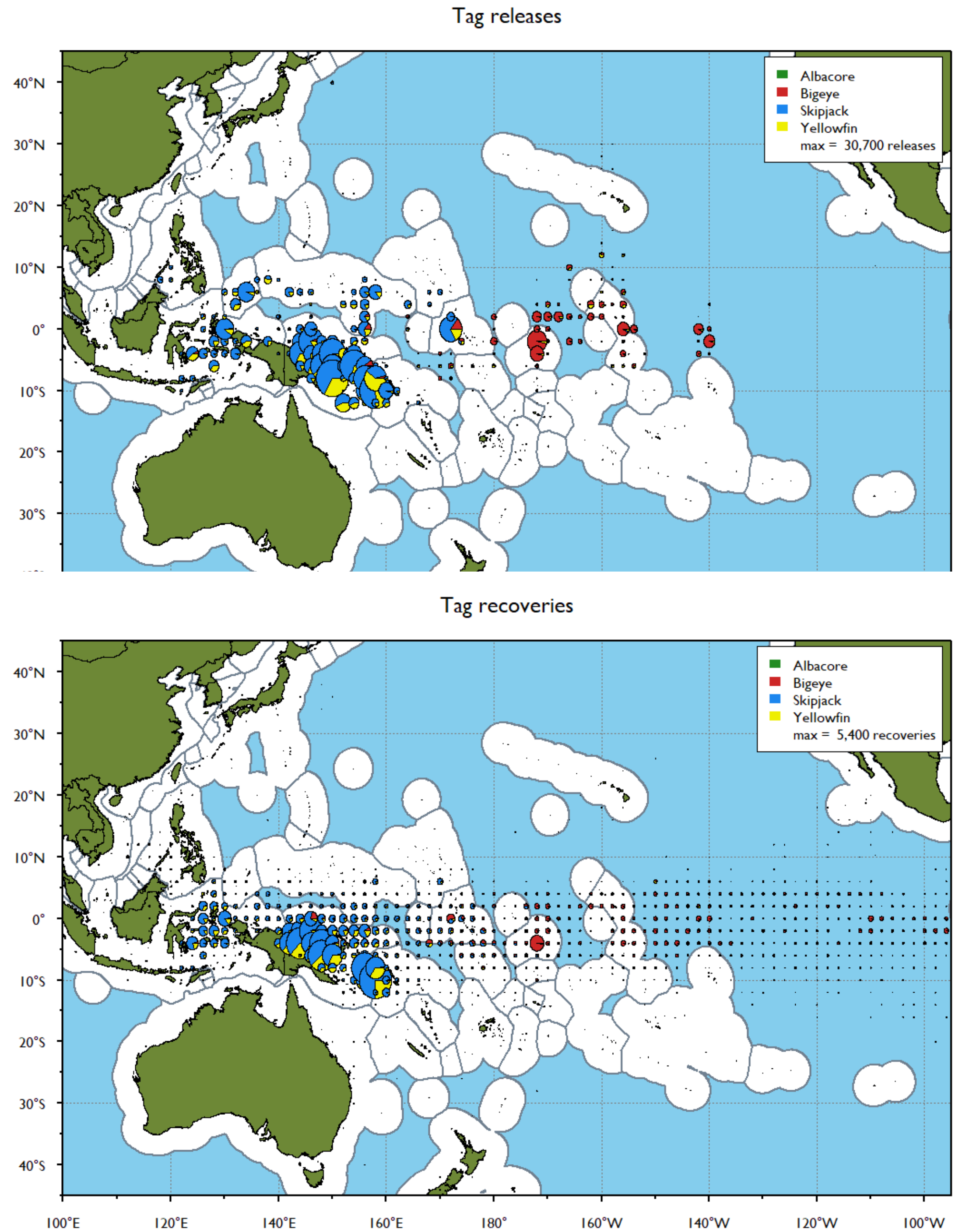


Figure 15: Tag releases (top) and recaptures (bottom) by species from the recent Pacific Tuna Tagging Programme (PTTP). Release and recovery locations have been aggregated to a 2° x 2° grid resolution for visual clarity.

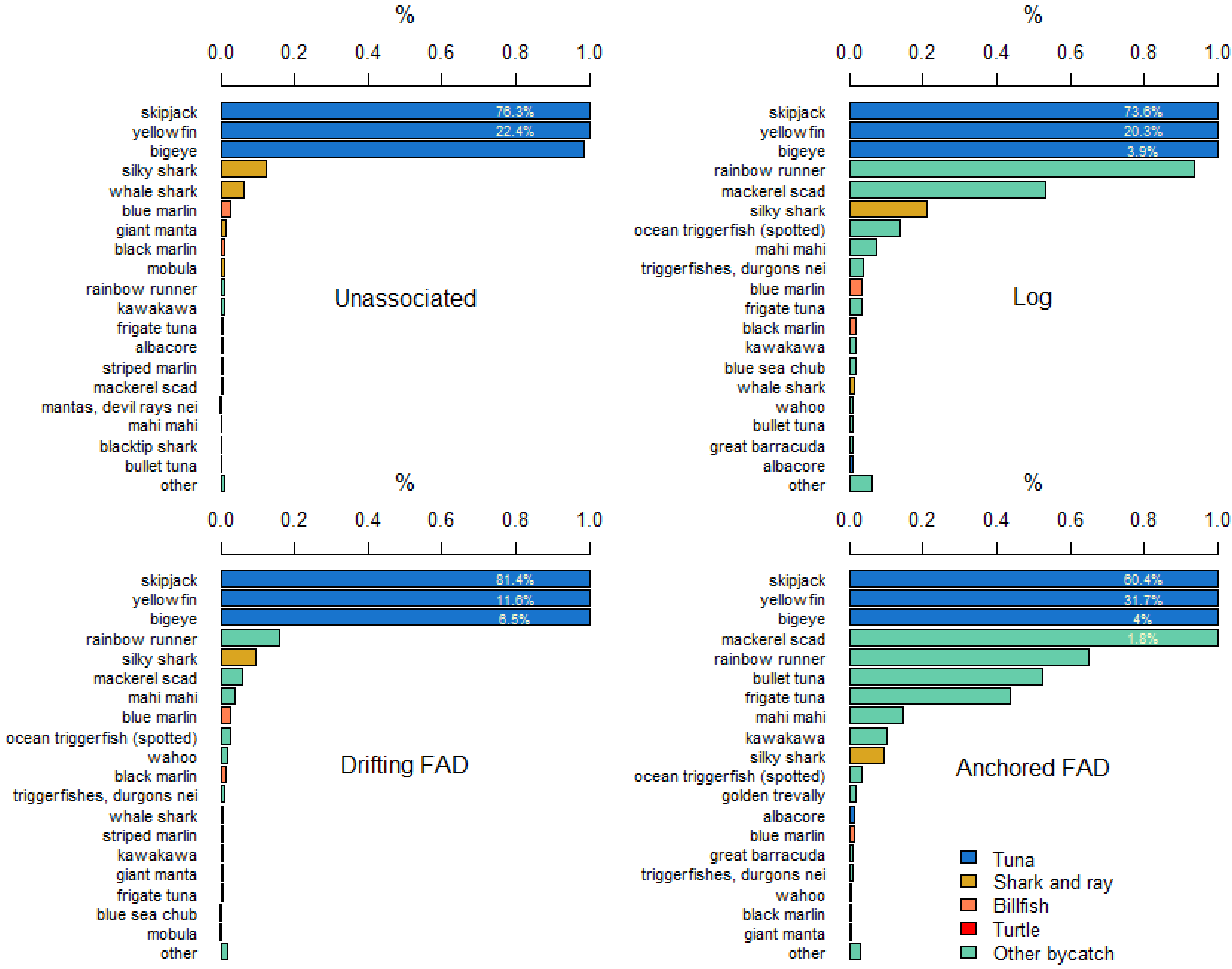


Figure 16: Catch composition of the various categories of purse seine fisheries operating in the WCPFC-CA based on observer data from the last five years' data. Note: Species comprising less than 0.01% of the catch are summed in the "other" category.

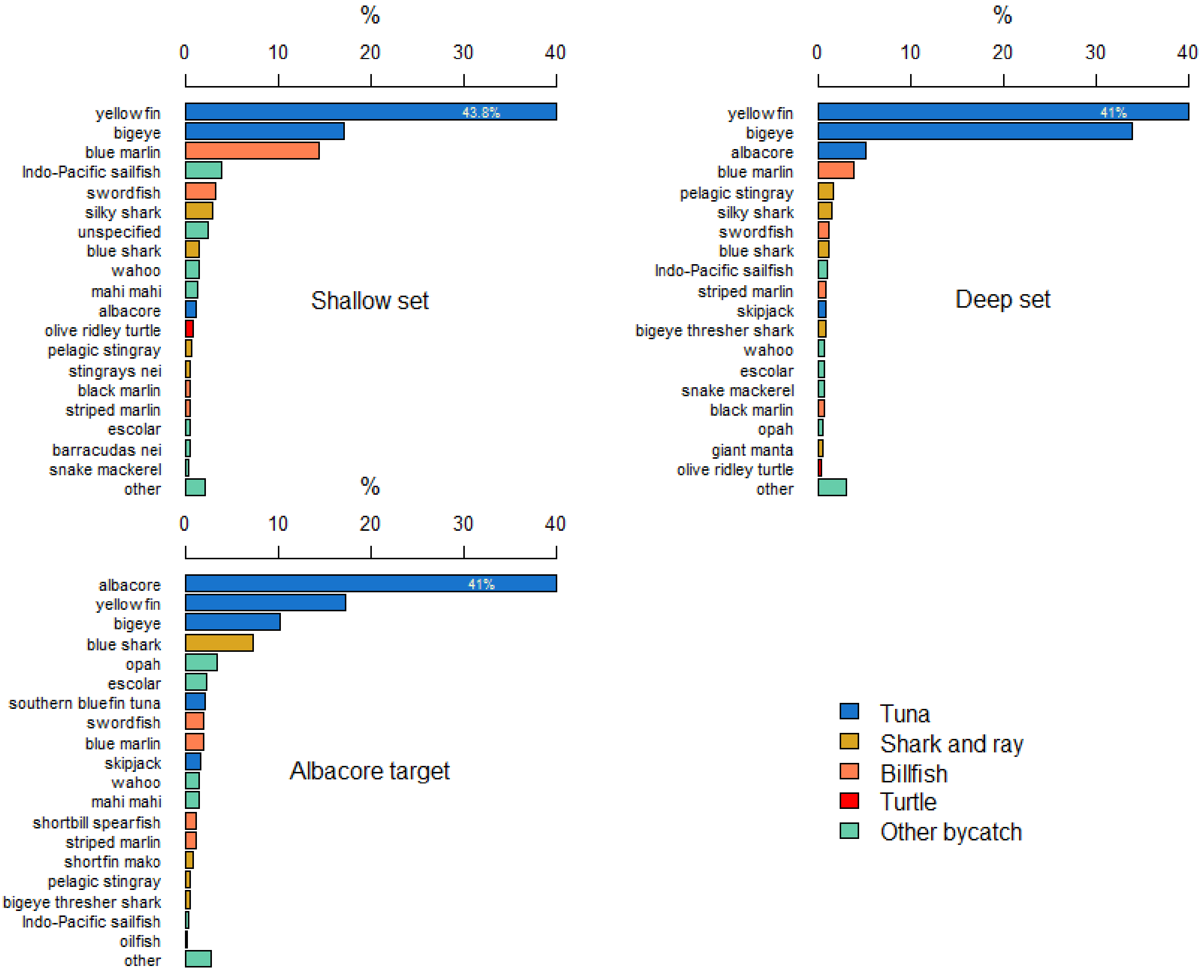


Figure 17: Catch composition of the various categories of longline fisheries operating in the WCPFC-CA based on observer data from the last five years' data.

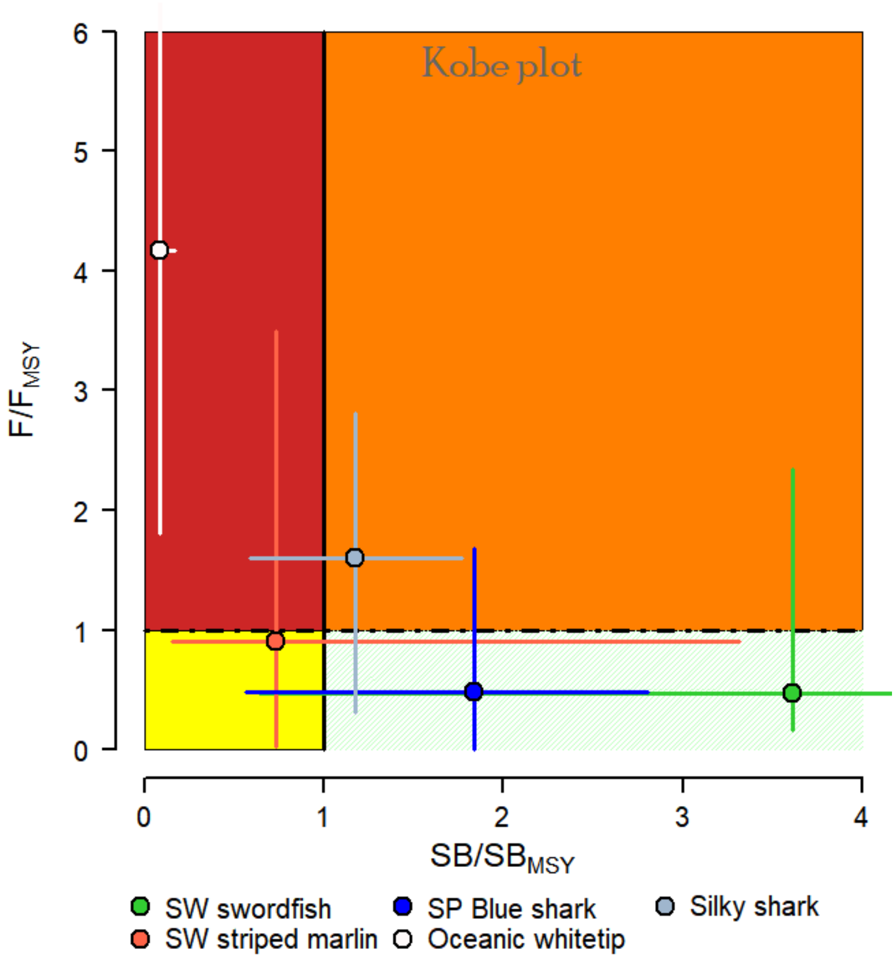


Figure 18: Kobe plot stock status summary for five species of billfishes and sharks assessed at SPC over the past decade and for which stock status has been determined. Note that this plot differs from that presented for the target tuna (the "Majuro" plot), because the WCPFC has not yet decided on LRPs for these species and therefore MSY-based reference points are used as a default.

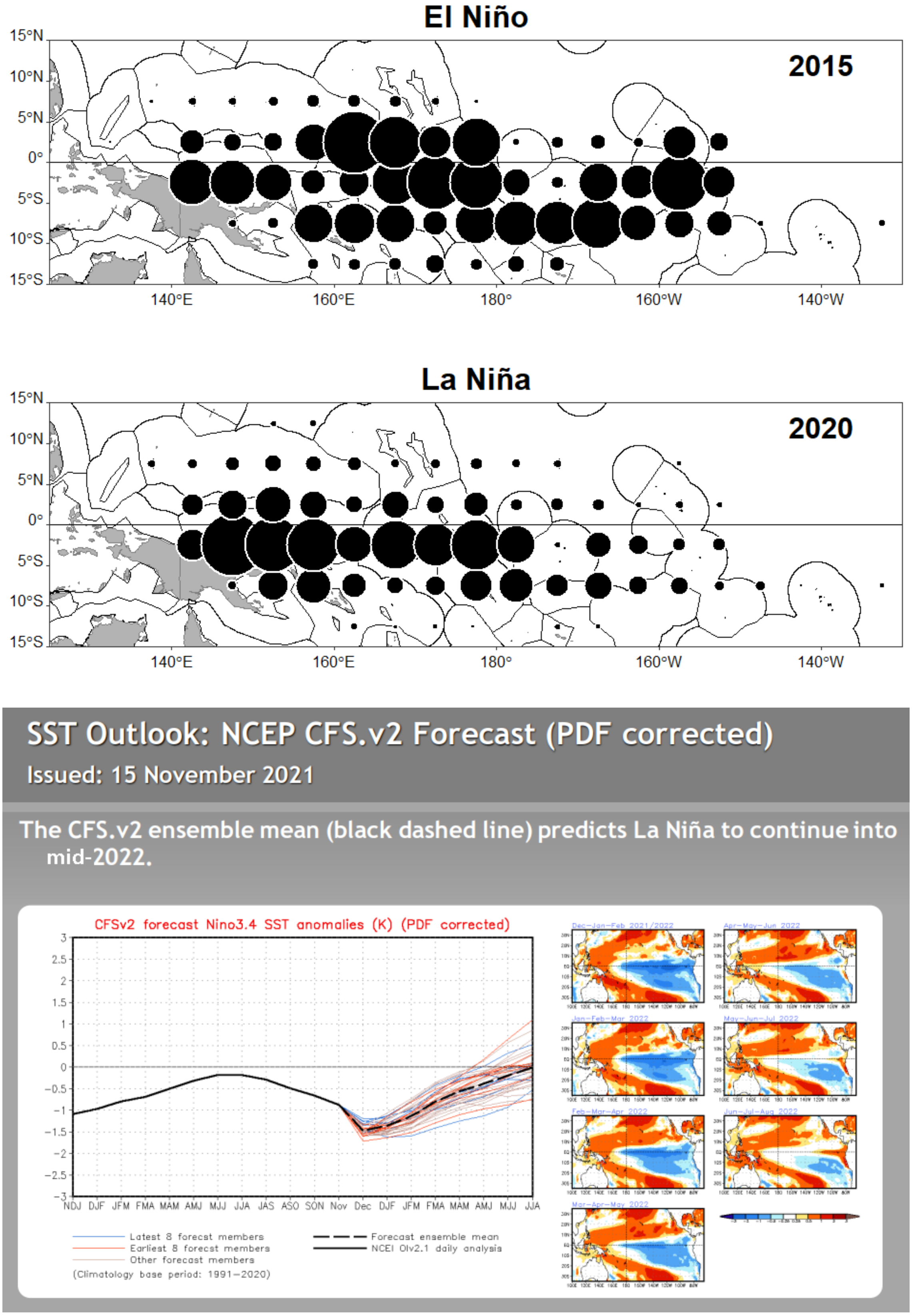


Figure 19: Illustration of difference in purse seine effort distribution between a strong El Niño (top) and strong La Niña event (middle). A medium strength La Niña event (overall negative sea surface temperature anomaly and westward extension of the "cold tongue" into the western Pacific) was declared in October 2021 and is forecasted to continue until June 2022 (source: https://www.cpc.ncep.noaa.gov, forecast date: 15 November 2021).

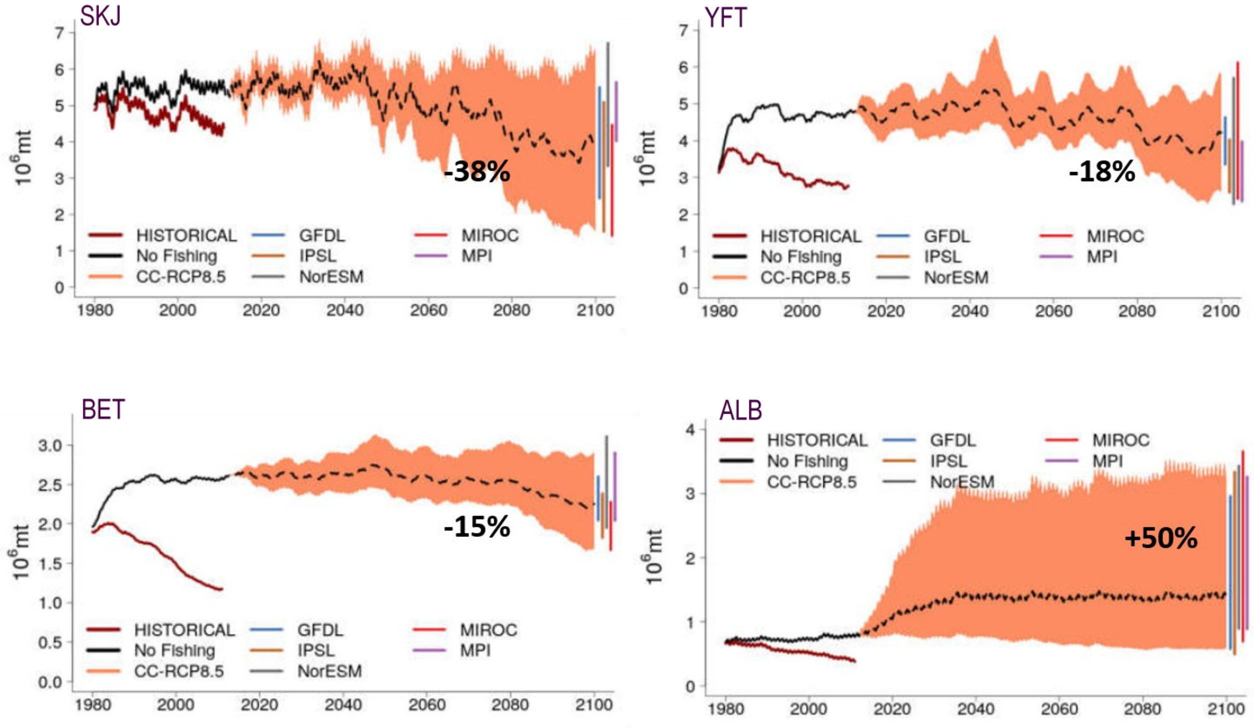


Figure 20: Envelope of predictions computed from simulation ensembles under IPCC RCP8.5 scenario for the WCPO for skipjack (SKJ), yellowfin (YFT), bigeye (BET) and albacore (ALB) tuna. The change in total biomass is presented with the average (dotted line) and its envelope bounded by the 5% and 95% quantile values of the simulation ensembles. The percentage values represent the change in the mean biomass across runs in the 1990–2010 time window compared with 2090–2100. Modified from Senina et al. (2018).

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