

**The Commission for the Conservation and Management of**

**Highly Migratory Fish Stocks in the Western and Central Pacific Ocean**

**Scientific Committee**

**WCPO Yellowfin Tuna (*Thunnus albacares*)**

Stock Status and Management Advice

**Contents**

[SC15 2019 (FISHERY INDICATORS UPDATED) 2](#_Toc24966478)

[SC14 2018 (FISHERY INDICATORS UPDATED) 2](#_Toc24966479)

[SC13 2017 (STOCK ASSESSMENT CONDUCTED) 3](#_Toc24966480)

[**Useful References** 13](#_Toc24966481)

[**Previous Assessments** 13](#_Toc24966482)

# SC15 2019 (FISHERY INDICATORS UPDATED)

1. **Stock status and trends**
2. SC15 noted that no stock assessment was conducted for WCPO yellowfin tuna in 2019. Therefore, the stock status description from SC13 is still current. For further information on the stock status and trends from SC13, please see <https://www.wcpfc.int/node/29904>
3. SC15 noted that the total yellowfin catch in 2018 was 666,971 mt (the second highest catch on record), a 2% decrease from 2017 and a 9% increase from the average 2013-2017.
4. Purse seine catch in 2018 (374,062 mt) was a 22% decrease from 2017 and a 1% increase from the 2013-2017 average. Longline catch in 2018 (94,509 mt) was an 11% increase from 2017 and a 4% increase from the 2013-2017 average. Pole and line catch (12,201 mt) was a 1% decrease from 2017 and a 48% decrease from the average 2013-2017 catch. Catch by other gear (186,199 mt) was a 79% increase from 2017 and 51% increase from the average catch in 2013-2017.
5. SC15 noted that under recent fishery conditions, the yellowfin stock is initially projected to increase as recent estimated recruitments support adult stock biomass. Adult stock biomass is then projected to decline slightly before again increasing. Projected fishing mortality is below FMSY (median F2020/FMSY = 0.74, the risk of F2020 > FMSY = 3%) and projected median spawning biomass is above the LRP (SB2020/SBF=0 = 0.2) (median SB2020/SBF=0 = 0.32; median SB2020/SBMSY = 1.33. Risk that SB2020 < LRP = 8%).
6. **Management advice and implications**
7. SC15 noted that no stock assessment has been conducted since SC13. Therefore, the advice from SC13 should be maintained, pending a new assessment or other new information. For further information on the management advice and implications from SC13, please see <https://www.wcpfc.int/node/29904>
8. **Research Recommendations**
9. SC15 encouraged the continuation of project 82 on yellowfin tuna age and growth for the next stock assessment.
10. SC15 noted that the following research issues need to be addressed for yellowfin tuna after classifying these research items as short-term (preferably before SC16) and long-term (preferably before the scheduled 2023 stock assessment).
    * + - 1. Carry out further otolith age validation studies for yellowfin in the western and central Pacific such as applying radiocarbon age validation (short to long-term).
          2. Compile a high confidence tagging dataset for growth analysis and develop an integrated growth model incorporating the tagging data and the otolith data (short-term).
          3. Continue to develop and document protocols for daily and annual ageing by IATTC and WCPFC (short-term).

# SC14 2018 (FISHERY INDICATORS UPDATED)

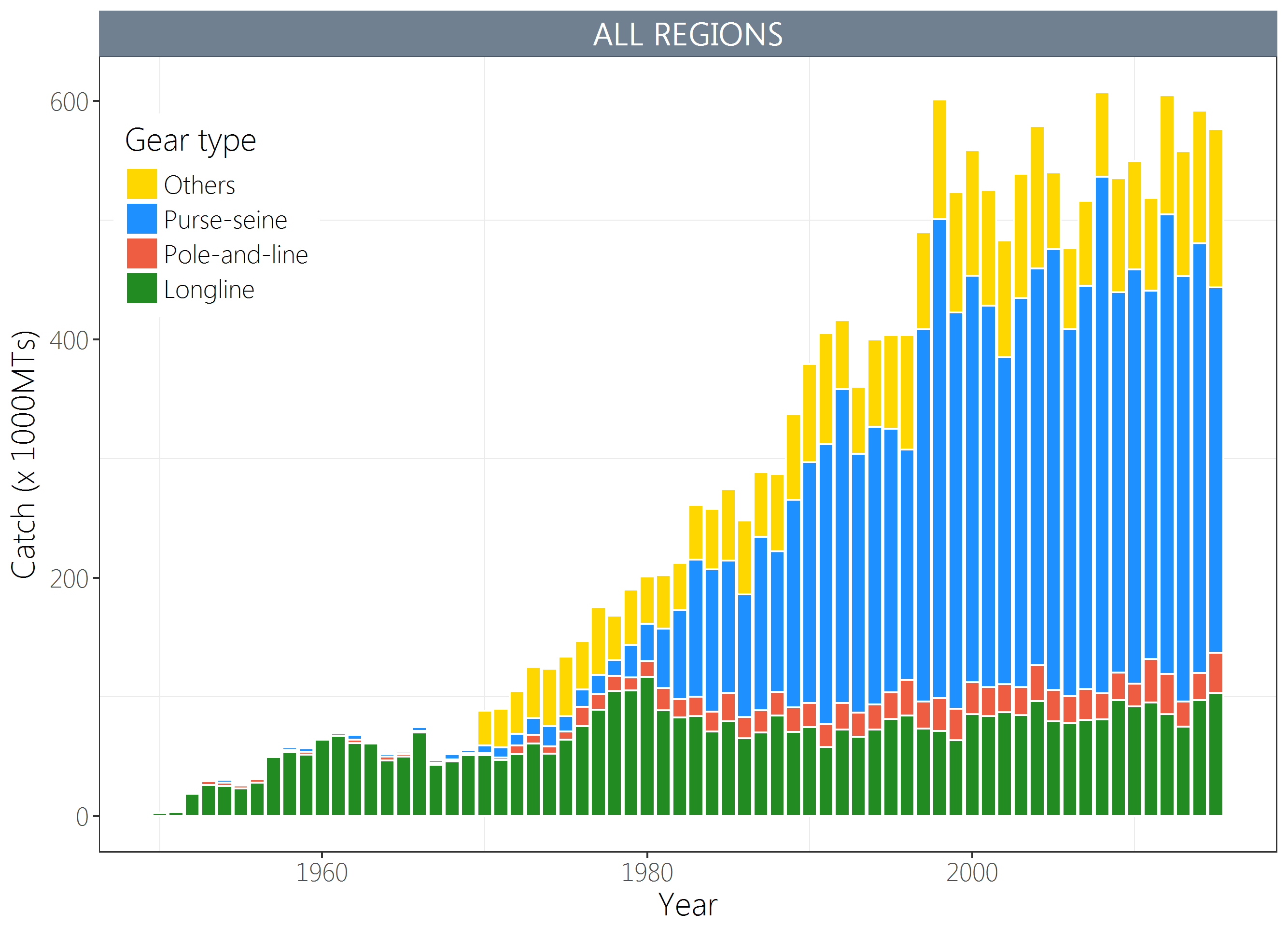
1. **Stock Status and trends**
2. SC14 noted that no stock assessment was conducted for WCPO yellowfin tuna in 2018. Therefore, the stock status description from SC13 is still current. For further information on the stock status and trends from SC13, please see below.
3. SC14 noted that the total yellowfin catch in 2017 was a record 670,890 mt, a 4% increase from 2016 and a 12% increase from the average 2012-2016.
4. Purse seine catch in 2017 (472,279mt) was a 22% increase from 2016 and a 33% increase from the 2012-2016 average. Longline catch in 2017 (83,399mt) was a 6% decrease from 2016 and a 9% decrease from the 2012-2016 average. Pole and line catch (12,219mt) was a 48% decrease from 2016 and a 56% decrease from the average 2012-2016 catch. Catch by other gear (102,993mt) was a 28% decrease from 2016 and 17% decrease from the average catch in 2012-2016.
5. SC14 noted that under recent fishery conditions, the yellowfin stock was initially projected to increase as recent estimated relatively high recruitments support adult stock biomass, then decline slightly. Median F2019/FMSY = 0.63; median SB2019/SBF=0 = 0.37; median SB2019/SBMSY = 1.51. Risk that SB2019 < LRP = 6%.
6. **Management advice and implications**
7. SC14 noted that no stock assessment has been conducted since SC13. Therefore, the advice from SC13 should be maintained to achieve the objectives set in CMM-2017-01, pending a new assessment or other new information. For further information on the management advice and implications from SC13, please see below.
8. **Research Recommendations**
9. SC14 reviewed the work on age and growth of yellowfin tuna presented in SA-WP-13 and noted that the final results of this projected will be presented to SC15. SC14 encouraged analysis of the same otoliths by different laboratories, to build confidence in ageing estimates through inter laboratory daily-annual age workshop.

# SC13 2017 (STOCK ASSESSMENT CONDUCTED)

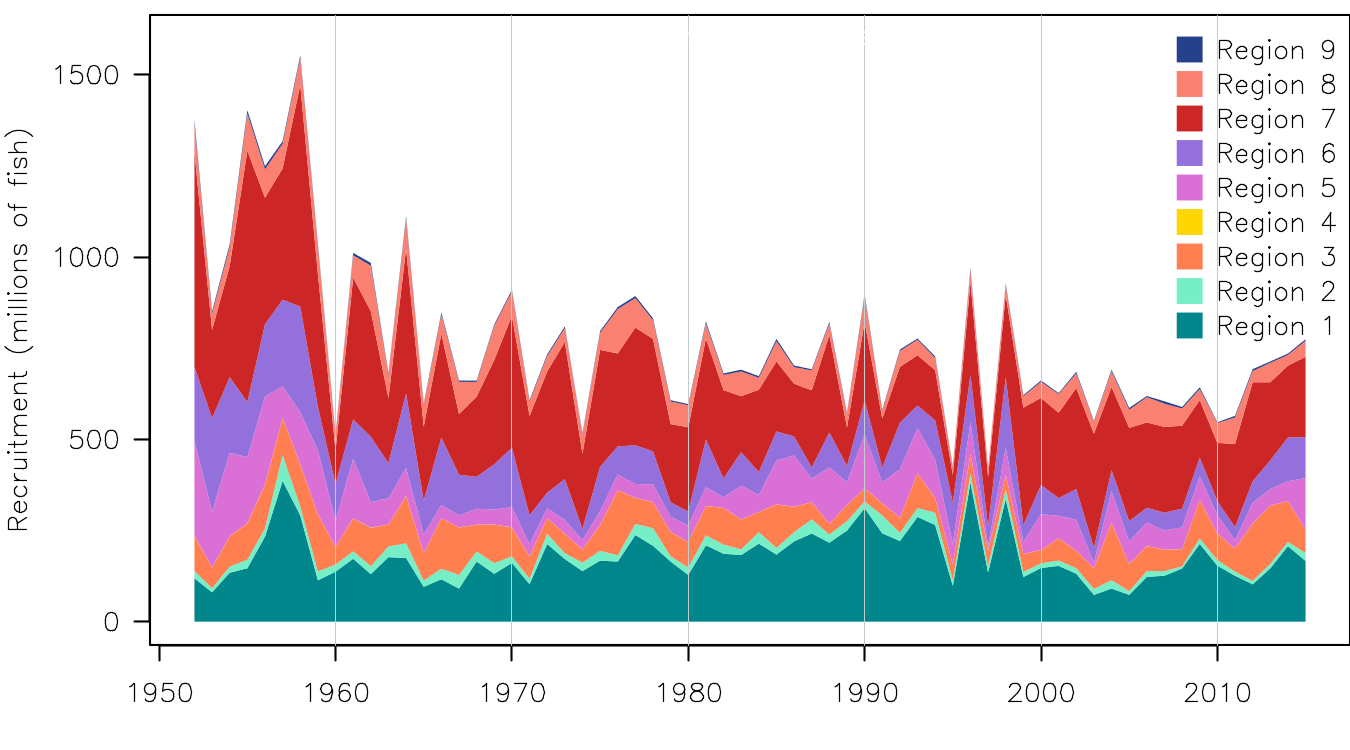
1. SC13 endorsed the 2017 WCPO yellowfin tuna stock assessment as the most advanced and comprehensive assessment yet conducted for this species.
2. SC13 also endorsed the use of the assessment model uncertainty grid to characterize stock status and management advice and implications.
3. SC13 reached consensus on the weighting of assessment models in the uncertainty grid for yellowfin tuna. The consensus weighting considered all options within five axes of uncertainty for steepness, tagging dispersion, tag mixing, size frequency (with two levels), and regional structure to be equally likely. The resulting uncertainty grid was used to characterize stock status, to summarize reference points as provided in the assessment document SC13-SA-WP-06, and to calculate the probability of breaching the adopted spawning biomass limit reference point (0.2\*SBF=0) and the probability of Frecent being greater than FMSY.
4. **Stock status and trends**
5. The median values of relative recent spawning biomass (2012-2015) (SBrecent/SBF=0) and relative recent fishing mortality (Frecent/FMSY) over the uncertainty grid were used to measure the central tendency of stock status. The values of the upper 90th and lower 10th percentiles of the empirical distributions of relative spawning biomass and relative fishing mortality from the uncertainty grid were used to characterize the probable range of stock status.
6. Descriptions of the updated structural sensitivity grid used to characterize uncertainty in the assessment are provided in Table YFT-1. Catch trend data is presented in Figure YFT-1. Estimated annual average recruitment, biomass, fishing mortality and depletion are shown in Figures YFT-2 – YFT-5. Majuro plots summarizing the results for each of the models in the structural uncertainty grid retained for management advice are represented in Figures YFT-6 and YFT-7. Figure YFT-8 and YFT-9 present Kobe plots summarizing the results for each of the models in the structural uncertainty grid. Figure YFT-10 provides estimated time-series (or “dynamic”) Majuro and Kobe plots from the yellowfin ‘diagnostic case’ model run. Figure YFT-11 shows estimates of reduction in spawning potential due to fishing by region, and over all regions attributed to various fishery groups (gear-types) for the diagnostic case model. Table YFT-2 provides a summary of reference points over the 48 models in the structural uncertainty grid (based on the SC decision to include size frequency weighting levels 20 and 50 only).

**Table YFT-1:** Description of the updated structural sensitivity grid used to characterize uncertainty in the assessment

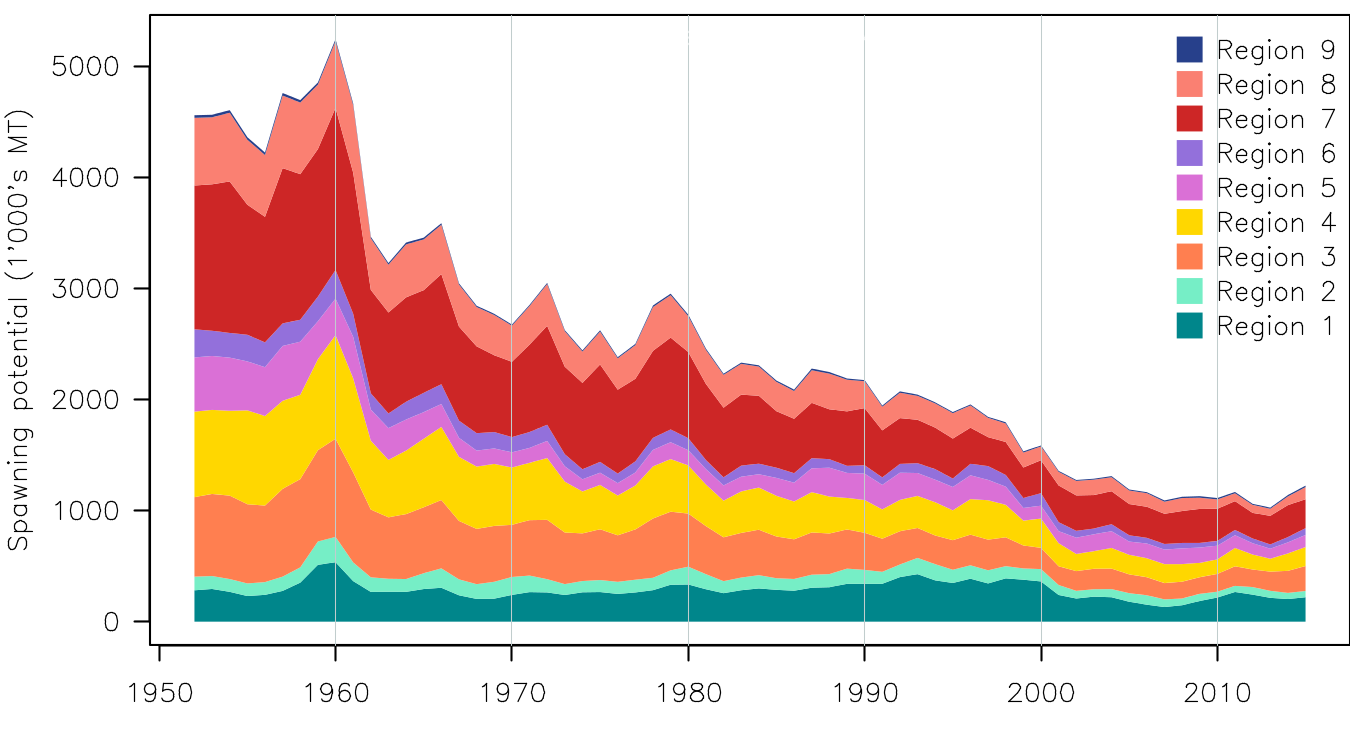
|  |  |  |
| --- | --- | --- |
| **Axis** | **Levels** | **Option** |
| Steepness | 3 | 0.65, 0.80, 0.95 |
| Tagging overdispersion | 2 | Default level (1), fixed (moderate) level |
| Tag mixing | 2 | 1 or 2 quarters |
| Size frequency weighting | 3 | Sample sizes divided by 10, 20, 50 |
| Regional structure | 2 | 2017 regions, 2014 regions |

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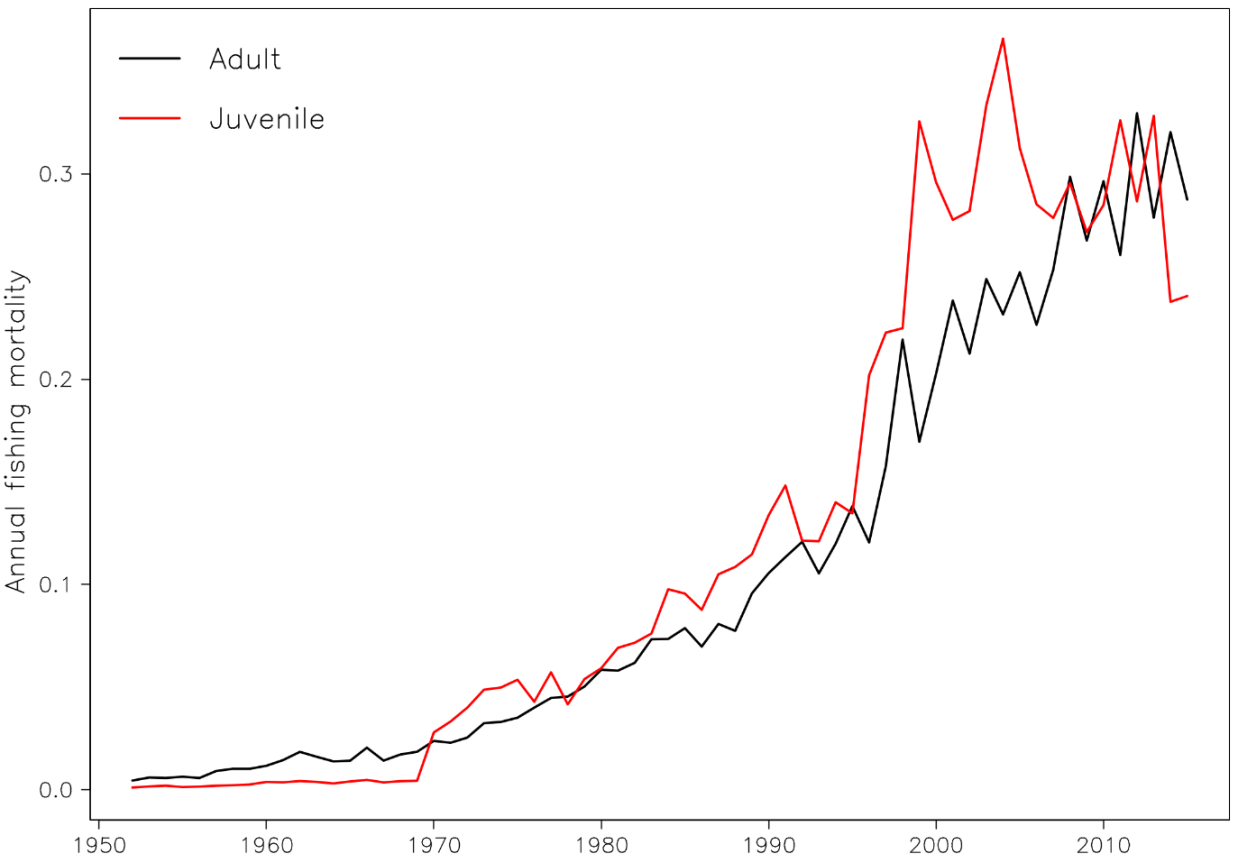
**Figure　YFT-1.** Time series of total annual catch (1000's mt) by fishing gear for the diagnostic case model over the full assessment period.



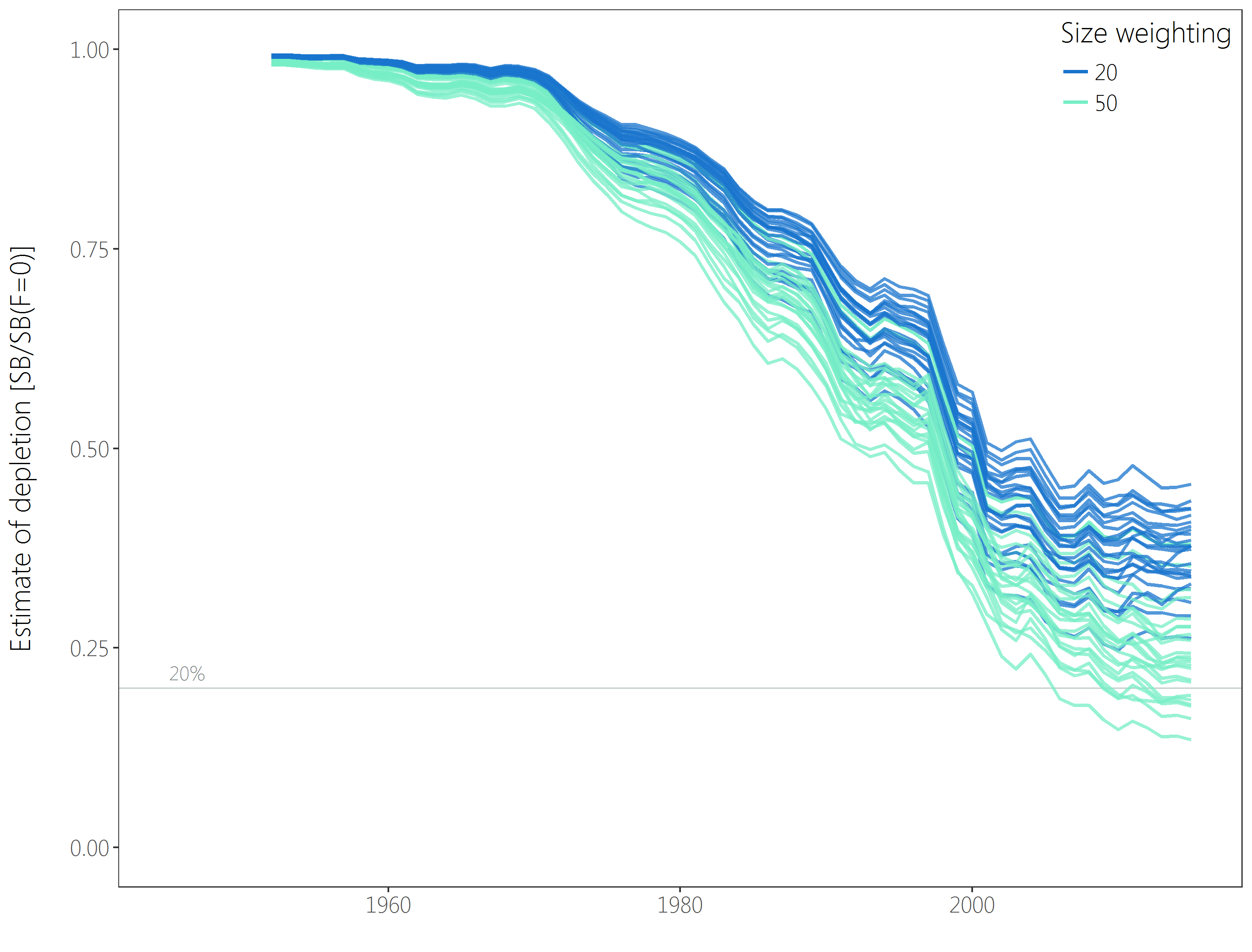
**Figure　YFT-2.** Estimated annual average recruitment by model region for the diagnostic case model, showing the relative sizes among regions.



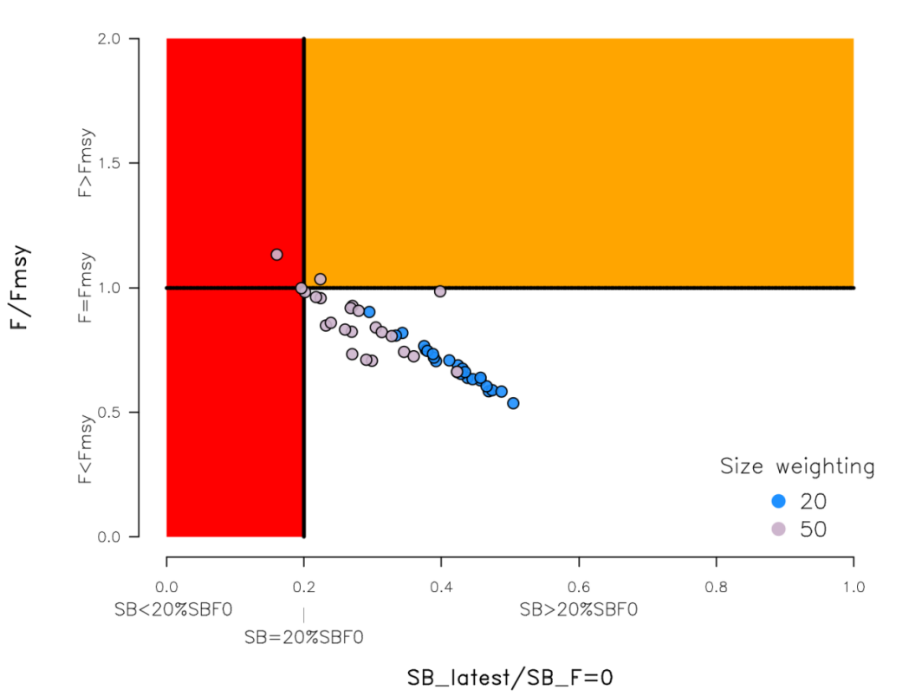
**Figure　YFT-3.** Estimated annual average spawning potential by model region for the diagnostic case model, showing the relative sizes among regions.

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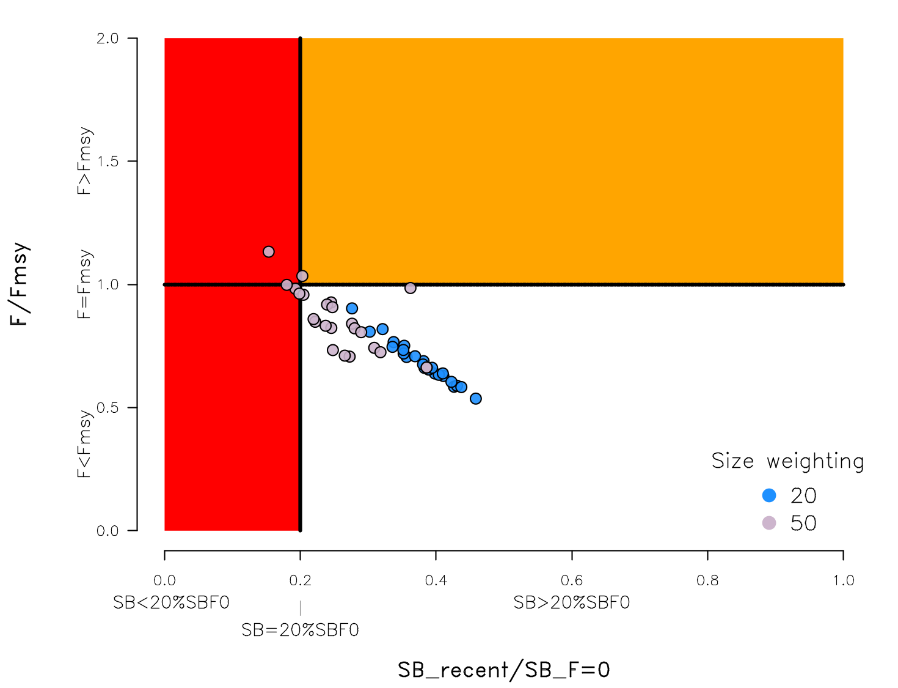
**Figure YFT-4.** Estimated annual average juvenile and adult fishing mortality for the diagnostic case model.



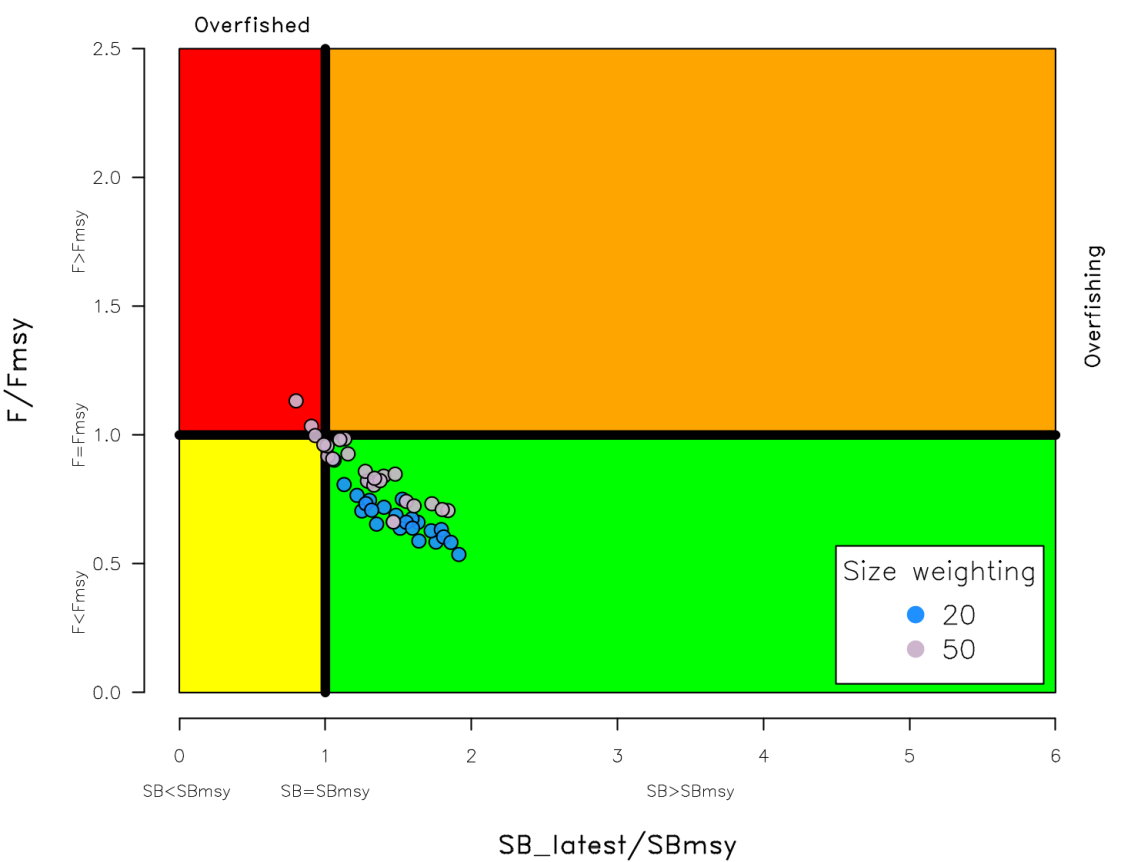
**Figure YFT-5**：Plot showing the trajectories of fishing depletion (of spawning potential) for the 48 model runs retained for the structural uncertainty grid used for management advice. The colours depict the models in the grid with the size composition weighting using divisors of 20 and 50.



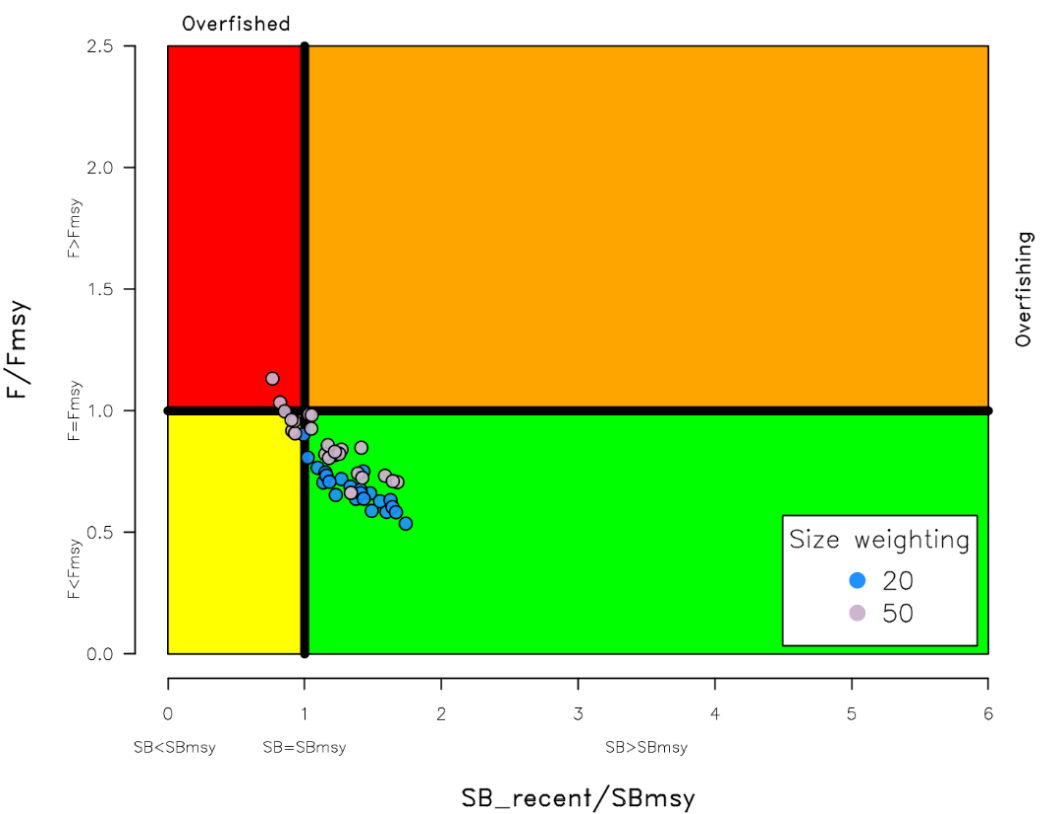
**Figure YFT-6.**  Majuro plot summarising the results for each of the models in the structural uncertainty grid retained for management advice. The plots represent estimates of stock status in terms of spawning potential depletion and fishing mortality. The red zone represents spawning potential levels lower than the agreed limit reference point which is marked with the solid black line. The orange region is for fishing mortality greater than FMSY (FMSY is marked with the black horizontal line). The points represent SBlatest/SBF=0, and the colours depict the models in the grid with the size composition weighting using divisors of 20 and 50.

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**Figure YFT-7:** Majuro plot summarising the results for each of the models in the structural uncertainty grid retained for management advice. The plots represent estimates of stock status in terms of spawning potential depletion and fishing mortality. The red zone represents spawning potential levels lower than the agreed limit reference point which is marked with the solid black line. The orange region is for fishing mortality greater than FMSY (FMSY is marked with the black horizontal line). The points represent SB*recent*/SB*F=0*, and the colours depict the models in the grid with the size composition weighting using divisors of 20 and 50.



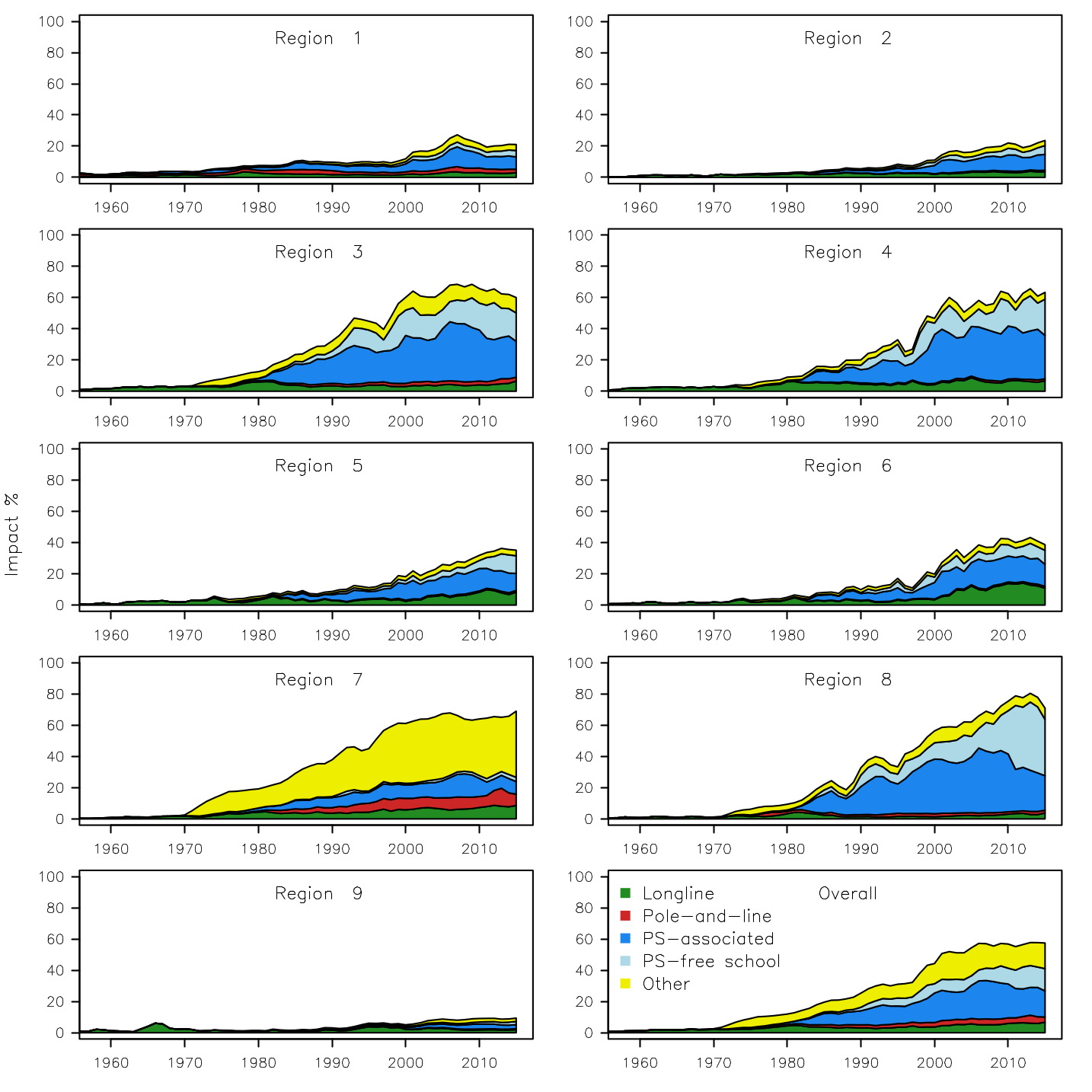
**Figure YFT-8.** Kobe plot summarising the results for each of the models in the structural uncertainty grid. The points represent SBlatest/SBMSY, the colours depict the models in the grid with the size composition weighting using divisors of 20 and 50.



**Figure YFT-9.** Kobe plot summarising the results for each of the models in the structural uncertainty grid. The points represent SB*recent*/SBMSY, the colours depict the models in the grid with the size composition weighting using divisors of 20 and 50.

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**Figure YFT-10.** Estimated time-series (or “dynamic”) Majuro and Kobe plots from the yellowfin ‘diagnostic case’ model run.

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**Figure YFT-11**. Estimates of reduction in spawning potential due to fishing by region, and over all regions (lower right panel), attributed to various fishery groups (gear-types) for the diagnostic case model.

**Table YFT-2**. Summary of reference points over the 48 models in the structural uncertainty grid retained for management advice using divisors of 20 and 50 for the weighting on the size composition data. Note that SB*recent*/SB*F=0* is calculated where SB*recent* is the mean SB over 2012-2015 instead of 2011-2014 (used in the stock assessment report), at the request of the Scientific Committee.

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| --- | --- | --- | --- | --- | --- | --- |
|  | **Mean** | **Median** | **Min** | **10%** | **90%** | **Max** |
| *Clatest* | 611,982 | 612,592 | 606,762 | 607,517 | 614,237 | 614,801 |
| *MSY* | 670,658 | 670,800 | 539,200 | 601,480 | 735,280 | 795,200 |
| *YFrecent* | 646,075 | 643,400 | 534,400 | 586,120 | 717,880 | 739,600 |
| *Fmult* | 1.34 | 1.36 | 0.88 | 1.03 | 1.61 | 1.86 |
| *F*MSY | 0.12 | 0.12 | 0.07 | 0.10 | 0.14 | 0.16 |
| *Frecent/F*MSY | 0.77 | 0.74 | 0.54 | 0.62 | 0.97 | 1.13 |
| *SB*MSY | 544,762 | 581,400 | 186,800 | 253,320 | 786,260 | 946,800 |
| *SB0* | 2,199,750 | 2,290,000 | 1,197,000 | 1,366,600 | 2,784,500 | 3,256,000 |
| *SB*MSY*/SB0* | 0.24 | 0.24 | 0.15 | 0.18 | 0.28 | 0.34 |
| *SBF=0* | 2,083,477 | 2,178,220 | 1,193,336 | 1,351,946 | 2,643,390 | 2,845,244 |
| *SB*MSY*/SBF=0* | 0.25 | 0.26 | 0.16 | 0.19 | 0.30 | 0.35 |
| *SBlatest /SB0* | 0.33 | 0.34 | 0.18 | 0.23 | 0.42 | 0.45 |
| *SBlatest /SBF=0* | 0.35 | 0.37 | 0.16 | 0.22 | 0.46 | 0.50 |
| *SBlatest /SB*MSY | 1.40 | 1.39 | 0.80 | 1.02 | 1.80 | 1.91 |
| *SBrecent/SBF=0* | 0.32 | 0.33 | 0.15 | 0.20 | 0.41 | 0.46 |
| *SBrecent/SB*MSY | 1.40 | 1.41 | 0.81 | 1.05 | 1.71 | 1.93 |

1. SC13 noted that the central tendency of relative recent spawning biomass was median (SBrecent/SBF=0) = 0.33 with a probable range of 0.20 to 0.41 (80% probable range), and there was a roughly 8% probability (4 out of 48 models) that the recent spawning biomass had breached the adopted LRP with Prob((SBrecent/SBF=0)<0.2) = 0.08. The median estimate (0.33) is　below that estimated from the 2014 assessment grid ((SBcurrent/SBF=0) = 0.41, see SC10-SA-WP-04), noting the differences in grid uncertainty axes used in that assessment.
2. SC13 noted that the central tendency of relative recent fishing mortality was median (Frecent/FMSY) = 0.74 with an 80% probability interval of 0.62 to 0.97, and there was a roughly 4% probability (2 out of 48 models) that the recent fishing mortality was above FMSY with Prob((Frecent/FMSY)>1) = 0.04. The median estimate (0.74) is also comparable to that estimated from the 2014 assessment grid (Fcurrent/FMSY = 0.76, see SC10-SA-WP-04)
3. SC13 noted that the assessment results show that the stock has been continuously declining for about 50 years since the late 1960’s.
4. SC13 also noted that levels of fishing mortality and depletion differ between regions, and that 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 (as shown in Figure 44 of SC13-SA-WP-06).
5. **Management advice and implications**
6. Based on the uncertainty grid adopted by SC13 the spawning biomass is highly likely above the biomass LRP and recent F is highly likely below FMSY, and therefore noting the level of uncertainties in the current assessment it appears that the stock is not experiencing overfishing 96% probability) and it appears that the stock is not in an overfished condition (92% probability).
7. Based on the diagnostic case, both juvenile and adult fishing mortality show a steady increase since the 1970s. Adult fishing mortality has increased continuously over most of the time series, while juvenile fishing mortality has stabilized since the late 1990s at a level similar to that now estimated for adult yellowfin.
8. SC13 reiterates its previous advice from SC10 that WCPFC could consider measures to reduce fishing mortality from fisheries that take juveniles, with the goal to increase to maximum fishery yields and reduce any further impacts on the spawning potential for this stock in the tropical regions.
9. SC13 also reiterates its previous advice from SC10 that measures should be implemented to maintain current spawning biomass levels until the Commission can agree on an appropriate target reference point (TRP).

**Research Recommendations**

1. SC13 recognized that reviewing yellowfin growth through a study of yellowfin otoliths collected from the WCPO and incorporating this into future assessments should be encouraged.

# **Useful References**

SC15- SA-WP-01 A compendium of fisheries indicators for tuna stocks. <https://www.wcpfc.int/node/42927>

SC15- SA-WP-02 Project 94: Workshop on yellowfin and bigeye age and growth. <https://www.wcpfc.int/node/42928>

SC15- SA-WP-03 Progress on yellowfin tuna age and growth in the WCPO (Project 82). <https://www.wcpfc.int/node/42929>

SC15- SA-IP-19 Report of the Workshop on Age and Growth of Bigeye and Yellowfin Tunas in the Pacific Ocean. <https://www.wcpfc.int/node/43329>

SC14-SA-WP-02 A compendium of fisheries indicators for tuna stocks. <https://www.wcpfc.int/node/30987>

SC14-SA-WP-13 Progress on yellowfin tuna age and growth in the WCPO WCPFC Project 82. <https://www.wcpfc.int/node/31097>

SC13-SA-WP-06 Stock assessment of yellowfin tuna in the western and central Pacific Ocean Rev 1 (26 July 2017). <https://www.wcpfc.int/node/29519>

SC13-SA-IP-06 Background analyses for the 2017 stock assessments of bigeye and yellowfin tuna in the western and central Pacific Ocean. <https://www.wcpfc.int/node/29530>

# **Previous Assessments**

SC10-SA-WP-04 Stock assessment of yellowfin tuna in the western and central Pacific Ocean Rev 1 (25 July 2014) <https://wcpfc.int/node/18997>

SC7-SA-WP-03 Stock assessment of yellowfin tuna in the western and central Pacific Ocean (Rev.1 - 03August2011). <https://wcpfc.int/node/2786>

SC5-SA-WP-03 Stock assessment of yellowfin tuna in the western and central Pacific Ocean. <https://wcpfc.int/node/2175>

SC3-SA-WP-01 Stock assessment of yellowfin tuna in the western and central Pacific Ocean, including an analysis of management options. <https://wcpfc.int/node/1649>

SC2-SA-WP-01 Stock assessment of yellowfin tuna in the western and central Pacific Ocean, including an analysis of management options. <https://wcpfc.int/node/1746>

SC1-SA-WP-01 Stock assessment of yellowfin tuna in the Western and Central Pacific Ocean. <https://wcpfc.int/node/1881>