# Framework 59 :
## Acceptable Biological Catches for American Plaice, Georges Bank Haddock, Gulf of Maine Haddock and Pollock

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**SSC Meeting**
***January 10, 2020***

# *Overview: PDT memo to SSC*

- Highlights the PDT's discussion of risk –
  biological, economic, and social
- Includes two supporting analysis:
  1. An overview of the SSC's use of constant ABCs and
  2. Economic impacts analysis using the Quota-Change model (QCM) which is run for the sector program (sectors) in the commercial groundfish fishery.
- Refers to previous PDT memo to the SSC, dated October 10, 2019 (as revised on 10/15/19) for additional information, including projections at 75%FMSY

# *Comparing constant quota and 75%FMSY quota approaches*

- *Biological*
  - Based on the 2019 assessments, GB haddock, GOM haddock, American plaice, and pollock are rebuilt, not overfished, and overfishing is not occurring.
  - Risk of overfishing appears to be low based on the 2019 stock assessment and projections.
  - Projections may be performing better for 3 of the 4 stocks based on the Wiedenmann and Jensen analysis.
  - Some caveats discussed with respect to uncertainty by stock.
- *Economic*
  - Economic impacts analysis using the QCM for sectors suggest no difference in predicted utilization between the two sets of quotas, driven largely by other limiting stocks in the multispecies fishery.
  - Some caveats discussed with respect to American plaice.
- *Social*
  - There may be some distributional impacts if quotas increase or decrease, depending on the extent that any given port or fishing community depends on the stocks in question and if the assumptions of the QCM are not fully met.
  - Trust among fishery participants is already low, so this would be a possible opportunity to increase trust among fishery stakeholders by ensuring that the appropriate steps are followed as outlined by the Council's own current ABC control rule for groundfish. Alternatively, in the past, industry has requested stability in quotas – which a constant quota approach could provide.

# *Overview of Presentation*

- *Biological - background on constant quotas, projection performance, and individual stock assessments with projected quotas*
- *Economic - summary of QCM results*
- *Social - summary of analysis*

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# Long Term Performance of Projections

Past experience has shown that the projections used to set future catch limits and plan rebuilding strategies do not perform well (i.e., projected catch does not result in the desired fishing mortality, and stock growth does not occur as expected). In 2011, the SSC asked the PDT to examine an alternative to using updated assessments for setting FY2012 – FY2014 ABCs. Simulation analyses showed that projections tend to be biased high – that is, they over-estimated stock growth and future catches (Brooks and Legault 2016 and Wiedenmann and Jensen 2017). This work led to the SSC's implementation of constant ABCs for several groundfish stocks.

= constant ABCs

= no projections

## Acceptable Biological Catch (ABC) US+Canada

| stock | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GB cod | 4,812 | 5,616 | 5,616 | 2,506 | 2,506 | 2,506 | 1,249 | 1,249 | 2285 | 2285 | 2285 |
| GOM cod | 8,530 | 9,012 | 6,700 | 1,550 | 1,550 | 386 | 500 | 500 | 703 | 703 | 703 |
| GB Haddock | 62,515 | 46,784 | 39,846 | 35,783 | 35,699 | 43,606 | 77,898 | 77,898 | 73,114 | 73,114 | 73,114 |
| GOM Haddock | 1,265 | 1,206 | 1,013 | 290 | 677 | 1,454 | 3,630 | 4,534 | 13,131 | 12,490 | 10,186 |
| GB Yellowtail Flounder | 1,500 | 2,650 | 1150 | 500 | 400 | 354 | 354 | 300 | 300 | 140 | 140 |
| SNE Yellowtail Flounder | 493 | 687 | 1,003 | 700 | 700 | 700 | 267 | 267 | 68 | 68 | 68 |
| CC/GOM Yellowtail Flounder | 863 | 1,041 | 1,159 | 548 | 548 | 548 | 427 | 427 | 511 | 511 | 511 |
| Plaice | 3,156 | 3,444 | 3,632 | 1,557 | 1,515 | 1,544 | 1,297 | 1,336 | 1,732 | 1,609 | 1,492 |
| Witch Flounder | 944 | 1,369 | 1,639 | 783 | 783 | 783 | 460 | 878 | 993 | 993 | 993 |
| GB Winter Flounder | 2,052 | 2,224 | 3,753 | 3,750 | 3,598 | 2,124 | 755 | 755 | 855 | 855 | 855 |
| GOM Winter Flounder | 238 | 1,078 | 1,078 | 1,078 | 1,078 | 510 | 810 | 810 | 447 | 447 | 447 |
| SNE/MA Winter Flounder | 644 | 897 | 626 | 1,676 | 1,676 | 1,676 | 780 | 780 | 727 | 727 | 727 |
| Redfish | 7,586 | 8,356 | 9,224 | 10,995 | 11,465 | 11,974 | 10,338 | 11,050 | 11,552 | 11,785 | 11,942 |
| White Hake | 2,832 | 3,295 | 3,638 | 4,177 | 4,642 | 4,713 | 3,816 | 3,686 | 2,971 | 2,971 | 2,971 |
| Pollock | 19,800 | 16,900 | 15,400 | 15,600 | 16,000 | 16,600 | 21,312 | 21,312 | 40,172 | 40,172 | 40,172 |
| Northern Windowpane Flounder | 169 | 169 | 173 | 151 | 151 | 151 | 182 | 182 | 92 | 92 | 92 |
| Southern Windowpane Flounder | 237 | 237 | 386 | 548 | 548 | 548 | 623 | 623 | 473 | 473 | 473 |
| Ocean Pout | 271 | 271 | 256 | 235 | 235 | 235 | 165 | 165 | 127 | 127 | 127 |
| Halibut | 71 | 78 | 85 | 99 | 109 | 119 | 158 | 158 | 137 | 137 | 137 |
| Wolffish | 83 | 83 | 83 | 70 | 70 | 70 | 82 | 82 | 90 | 90 | 90 |

# Constant ABCs based on the lowest catch from the 75%$F_{MSY}$ projections

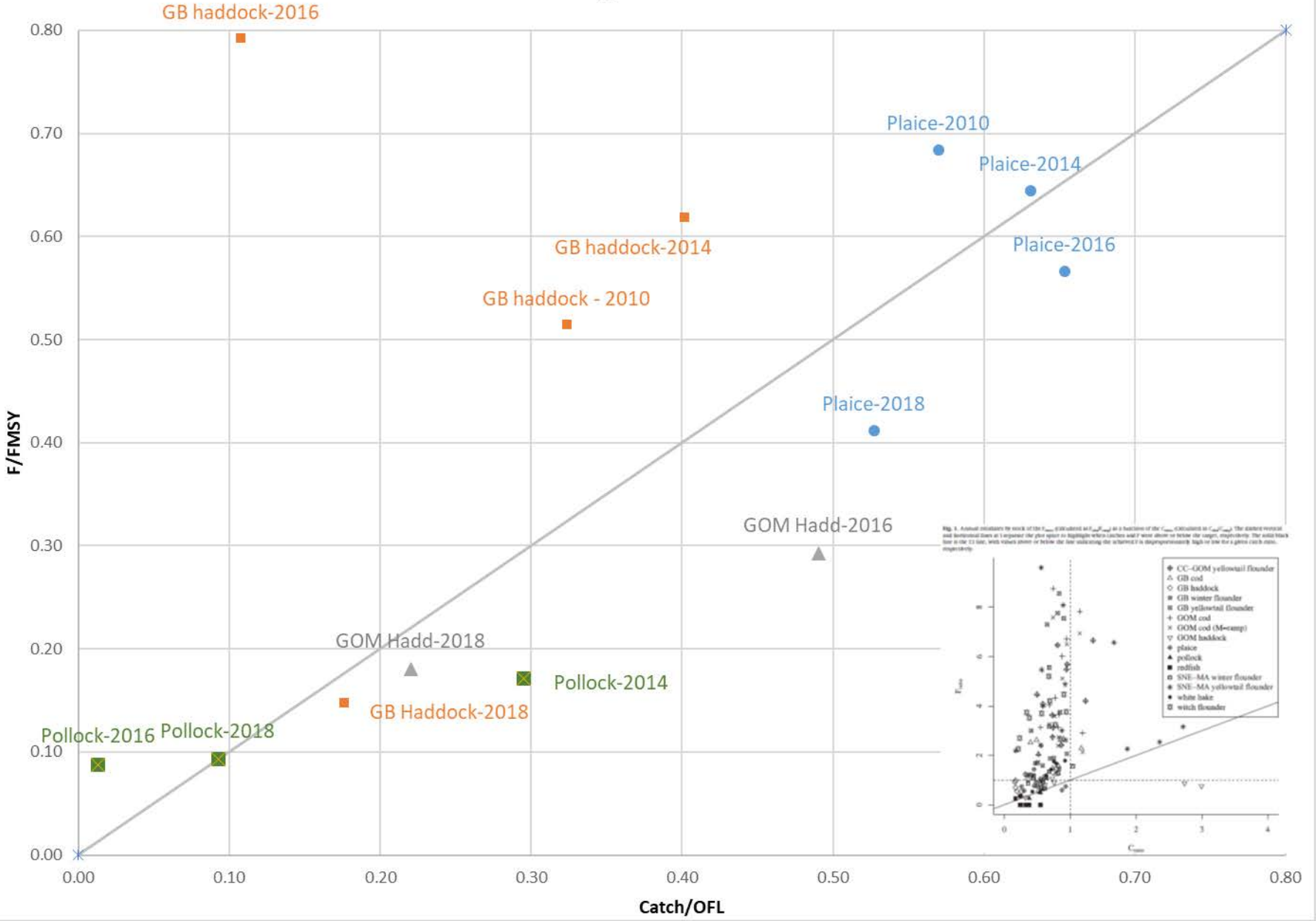
- In October 2019 the SSC decided to set constant ABCs for all stock assessments that have major retrospective errors regards of the stock status.
- Uncertainty buffers will be greatest in the first year and decrease in the out years when using the constant ABC approach for stocks with the lowest catch in the third year (i.e., 2022).

# Projections with decreasing SSB

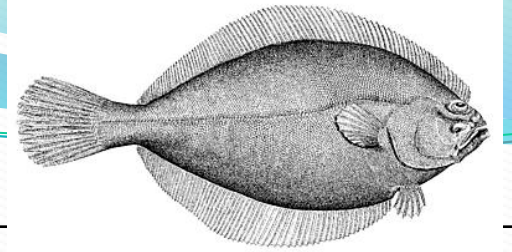
There are two possible reasons why a projection will decline assuming fishing mortality ≤ $F_{MSY}$ in the projections.

1. The biomass is greater than $B_{MSY}$. Here the projections are fishing the stock down to the target biomass reference point. In this case we are usually increasing the fishing mortality rate in the projection relative to the terminal year in the stock assessment.
2. Year class effects in the pipeline aging through the projections. Usually caused by a large year class aging through the projection. These effects are more dramatic when a dome shaped selectivity exists since the fish are also aging into the cryptic biomass. Poor year class moving through the projections could also result in a declining projection in the short term. Year class effects can become complicated because the end result is from the combined effect from several years through time.

# Mortality/Catch Ratios



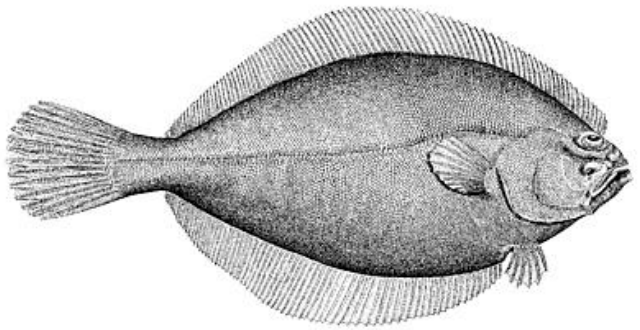
# American Plaice



| | |
|---|---|
| ***MODEL*** | VPA (Level 2) |
| ***STOCK STATUS*** | Not Overfished & Overfishing is not occurring |
| ***REBUILDING*** | Rebuilt (end date 2024) |
| ***RETROSPECTIVE ADJUSTMENT*** | Yes |
| ***UNCERTAINTIES*** | Evidence of growth differences between fish on Georges Bank and Gulf of Maine. |
| ***REVIEWER COMMENTS And Changes*** | The retrospective pattern remains a source of uncertainty. MDMF survey was excluded from the 2019 assessment due to concerns that the declining trends may reflect a movement of the stock offshore instead of decline in the population itself. Exclusion of the MA DMF survey resulted in higher biomass estimates that are more consistent with those from the area-swept survey estimates. |

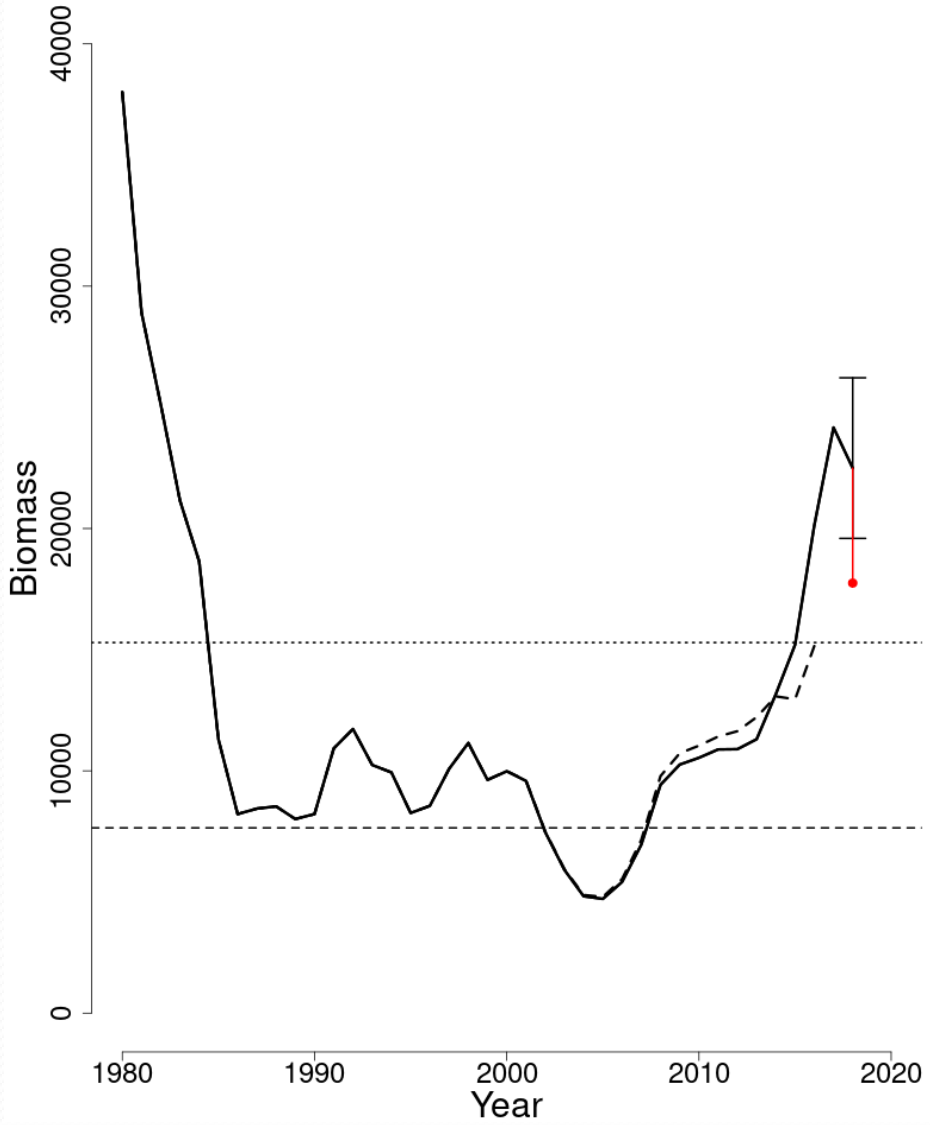
# American Plaice

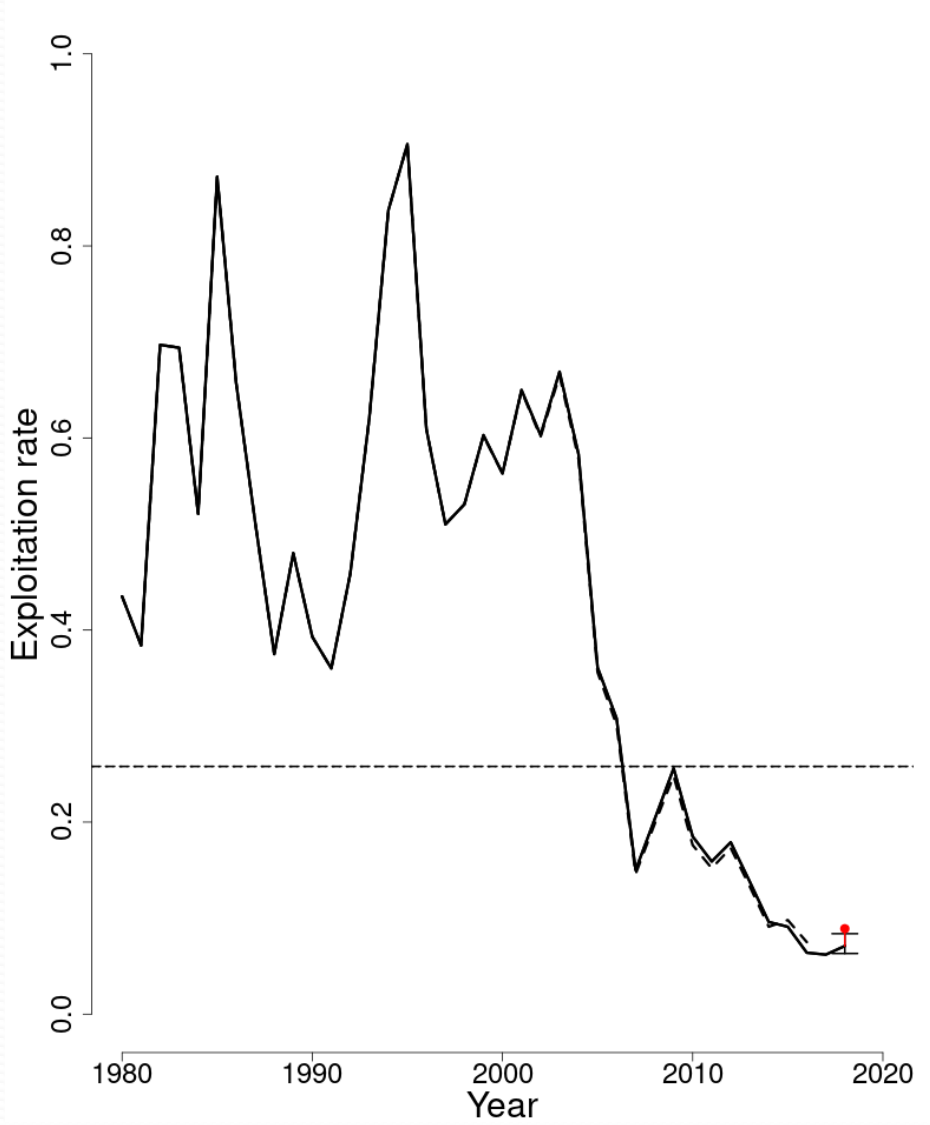
| | 2017 | 2019 |
|---|---|---|
| $F_{MSY}$ *proxy* | 0.216 | 0.258 |
| $SSB_{MSY}$ (mt) | 13,503 | 15,293 (11,706 - 20,432) |
| MSY (mt) | 2,942 | 3,301 (2,531 - 4,386) |
| Median recruits (age 1) (000s) | 21,969 | 22,414 |
| *Overfishing* | No | No |
| *Overfished* | No | No |



$SSB/SSB_{MSY} = 1.16$ and $F/F_{MSY} = 0.09$

# American Plaice



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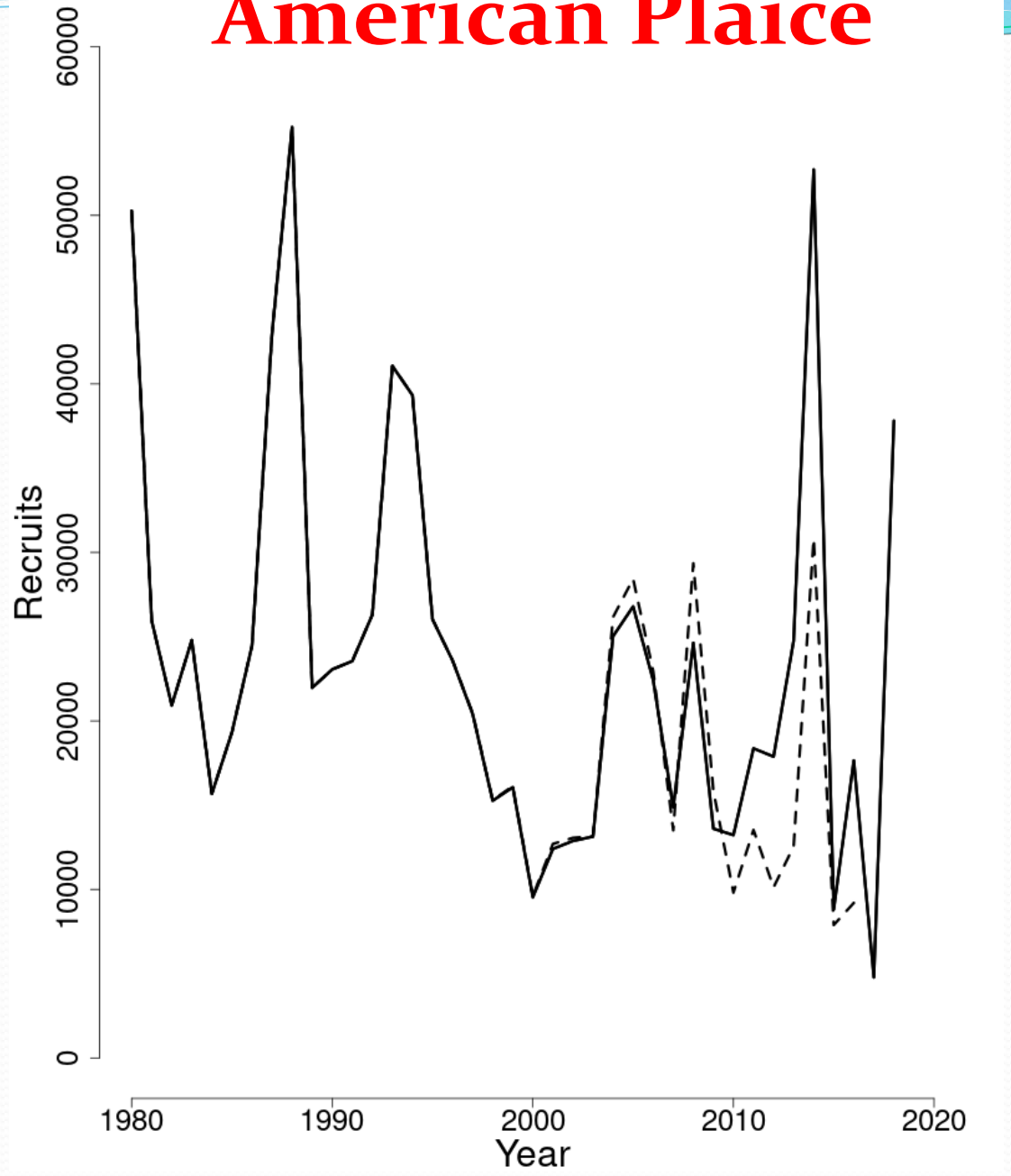

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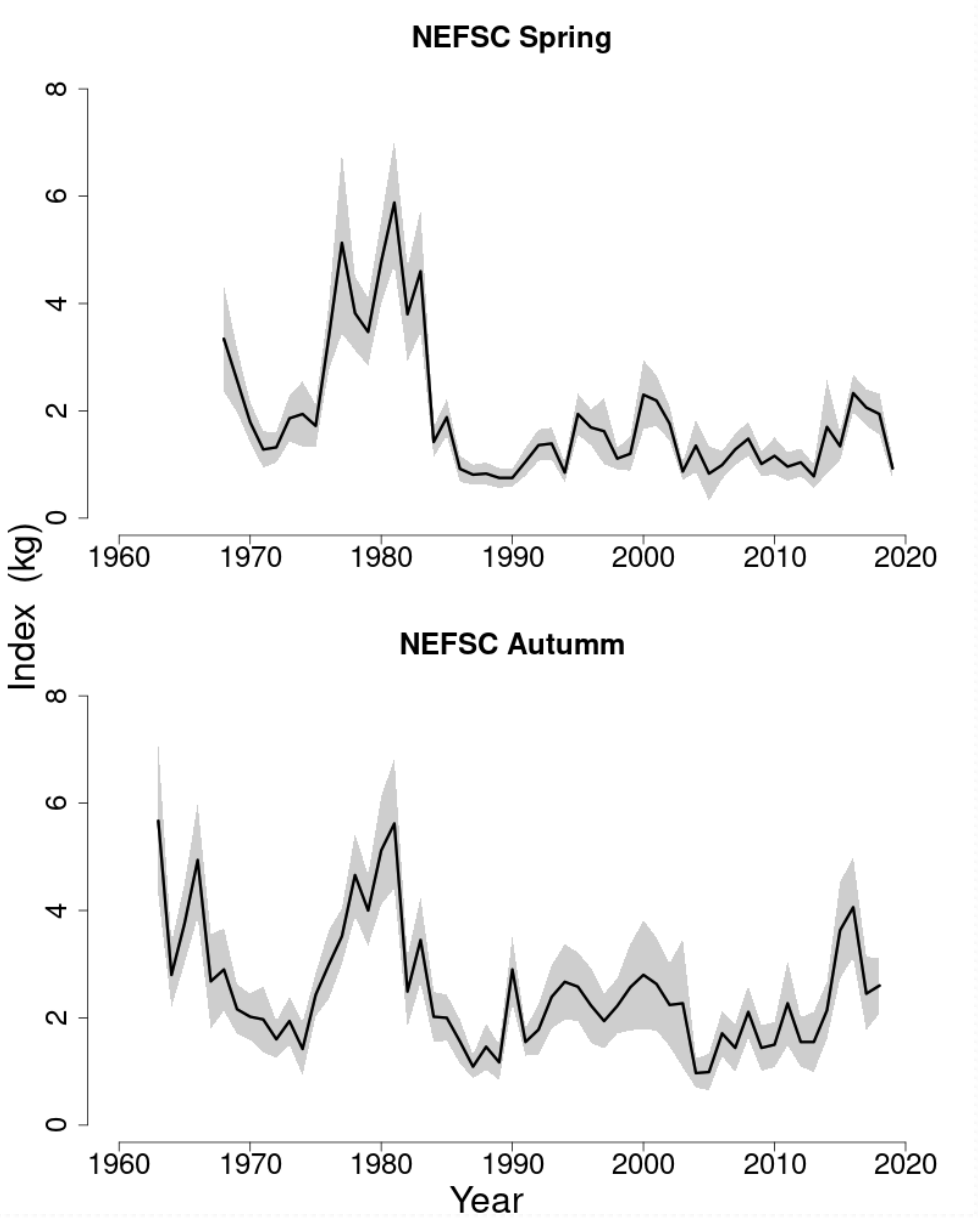


# American Plaice

| Age | stock wt | selectivity | maturity |
|---|---|---|---|
| 1 | 0.008 | 0.003 | 0.034 |
| 2 | 0.030 | 0.066 | 0.132 |
| 3 | 0.108 | 0.117 | 0.412 |
| 4 | 0.266 | 0.444 | 0.762 |
| 5 | 0.417 | 0.689 | 0.932 |
| 6 | 0.517 | 0.824 | 0.978 |
| 7 | 0.588 | 1.000 | 0.996 |
| 8 | 0.651 | 1.000 | 0.998 |
| 9 | 0.712 | 1.000 | 1.000 |
| 10 | 0.760 | 1.000 | 1.000 |
| 11+ | 0.872 | 1.000 | 1.000 |

# American Plaice

Total Stock Biomass

| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 150 | 173 | 173 | 173 |
| 2 | 608 | 476 | 548 | 548 |
| 3 | 224 | 1,773 | 1,376 | 1,586 |
| 4 | 2,023 | 448 | 3,503 | 2,709 |
| 5 | 1,329 | 2,522 | 533 | 4,156 |
| 6 | 7,886 | 1,288 | 2,265 | 476 |
| 7 | 3,149 | 6,944 | 1,039 | 1,815 |
| 8 | 1,705 | 2,673 | 5,311 | 783 |
| 9 | 1,202 | 1,431 | 2,005 | 3,953 |
| 10 | 790 | 981 | 1,052 | 1,451 |
| 11+ | 2,425 | 2,559 | 2,552 | 2,570 |
| total | 21,491 | 21,269 | 20,357 | 20,218 |

Proportions (Total Stock Biomass)

| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 0.01 | 0.01 | 0.01 | 0.01 |
| 2 | 0.03 | 0.02 | 0.03 | 0.03 |
| 3 | 0.01 | 0.08 | 0.07 | 0.08 |
| 4 | 0.09 | 0.02 | 0.17 | 0.13 |
| 5 | 0.06 | 0.12 | 0.03 | 0.21 |
| 6 | 0.37 | 0.06 | 0.11 | 0.02 |
| 7 | 0.15 | 0.33 | 0.05 | 0.09 |
| 8 | 0.08 | 0.13 | 0.26 | 0.04 |
| 9 | 0.06 | 0.07 | 0.10 | 0.20 |
| 10 | 0.04 | 0.05 | 0.05 | 0.07 |
| 11+ | 0.11 | 0.12 | 0.13 | 0.13 |

Exploitable Biomass

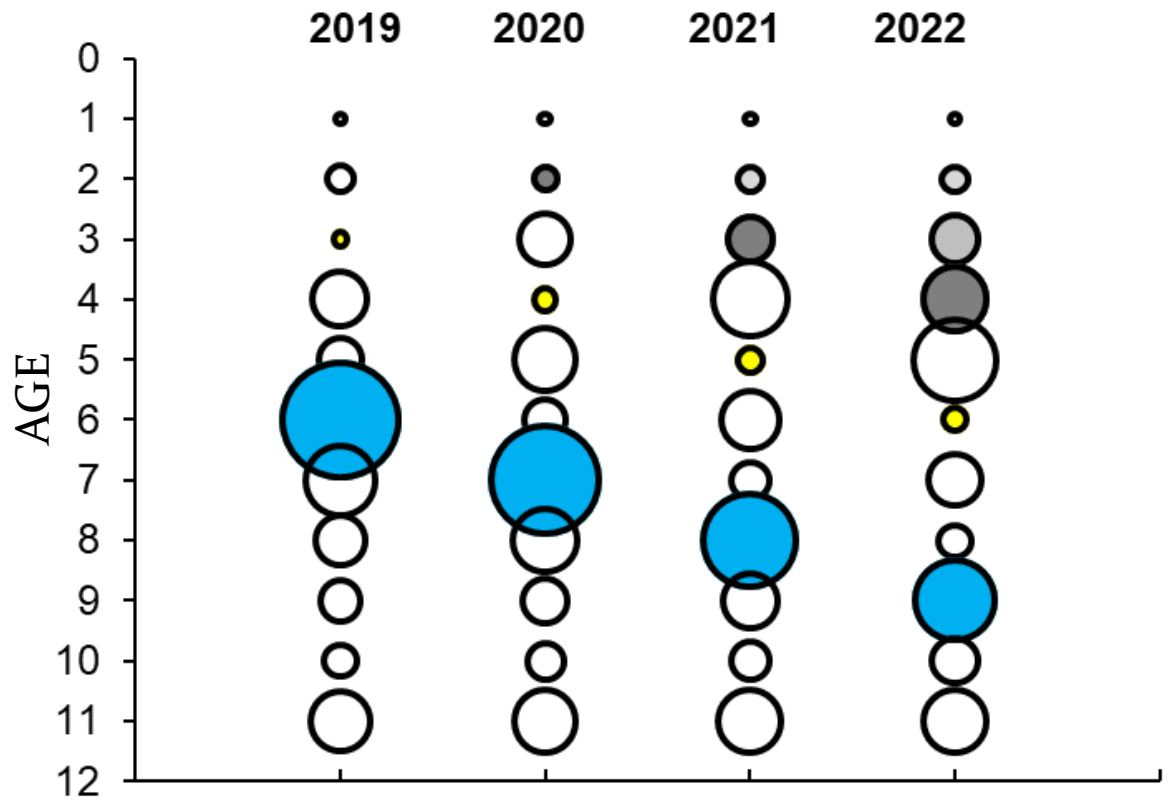
| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| 2 | 40 | 31 | 36 | 36 |
| 3 | 26 | 208 | 161 | 186 |
| 4 | 897 | 199 | 1,554 | 1,202 |
| 5 | 916 | 1,739 | 367 | 2,865 |
| 6 | 6,496 | 1,061 | 1,866 | 392 |
| 7 | 3,149 | 6,944 | 1,039 | 1,815 |
| 8 | 1,705 | 2,673 | 5,311 | 783 |
| 9 | 1,202 | 1,431 | 2,005 | 3,953 |
| 10 | 790 | 981 | 1,052 | 1,451 |
| 11+ | 2,425 | 2,559 | 2,552 | 2,570 |
| total | 17,647 | 17,827 | 15,945 | 15,253 |

Proportions (Exploitable Biomass)

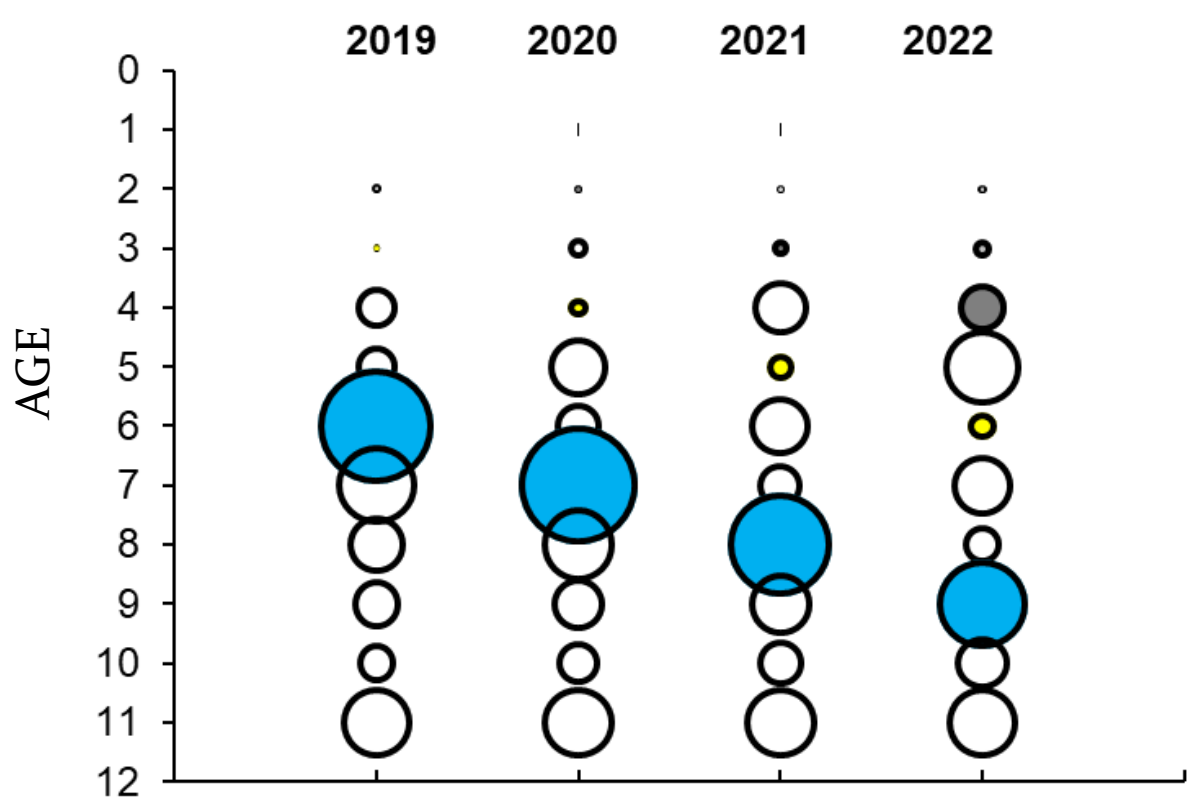
| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.01 | 0.01 | 0.01 |
| 4 | 0.05 | 0.01 | 0.10 | 0.08 |
| 5 | 0.05 | 0.10 | 0.02 | 0.19 |
| 6 | 0.37 | 0.06 | 0.12 | 0.03 |
| 7 | 0.18 | 0.39 | 0.07 | 0.12 |
| 8 | 0.10 | 0.15 | 0.33 | 0.05 |
| 9 | 0.07 | 0.08 | 0.13 | 0.26 |
| 10 | 0.04 | 0.06 | 0.07 | 0.10 |
| 11+ | 0.14 | 0.14 | 0.16 | 0.17 |

# American Plaice

Stock Biomass




Exploitable Biomass



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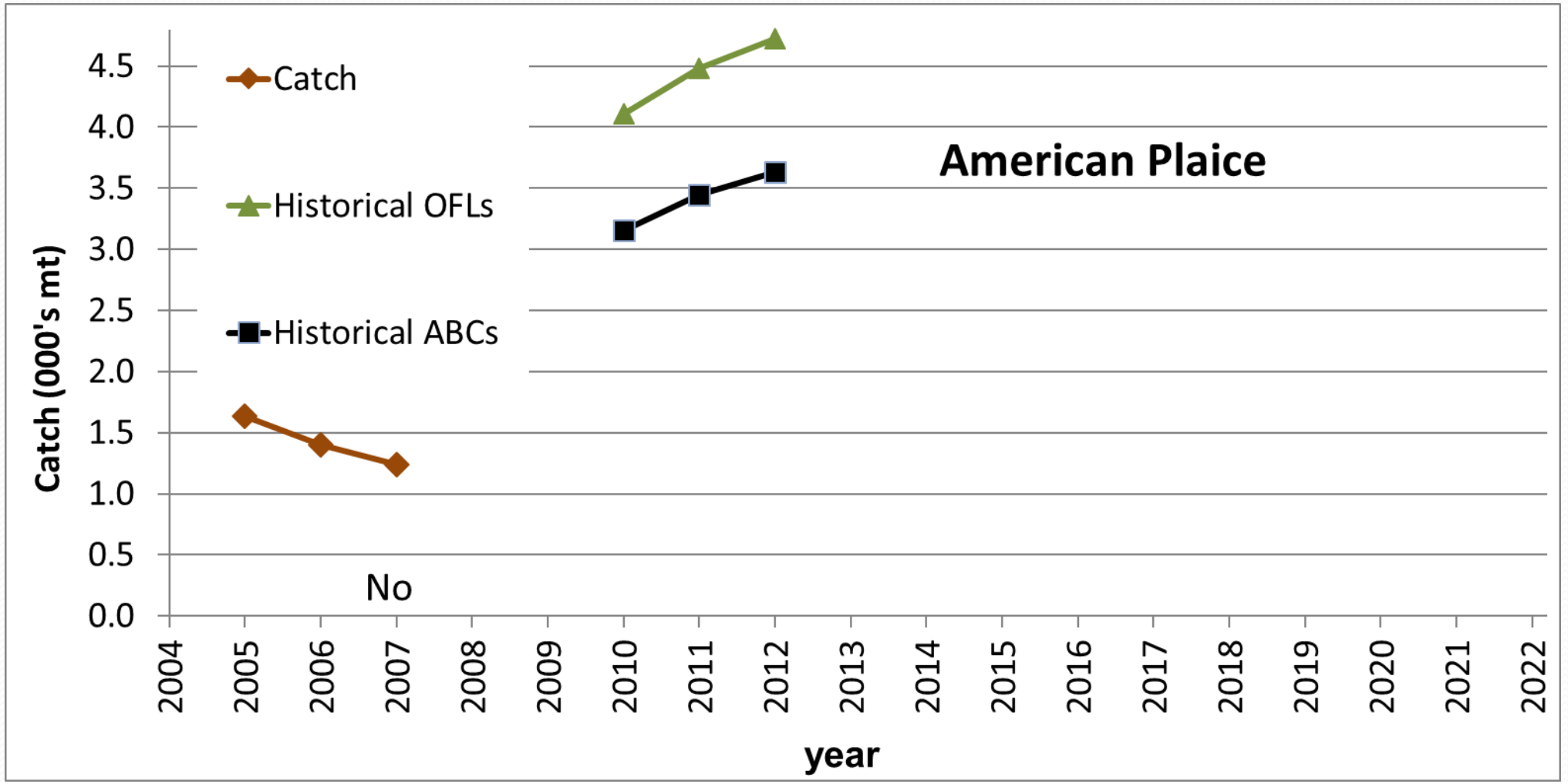

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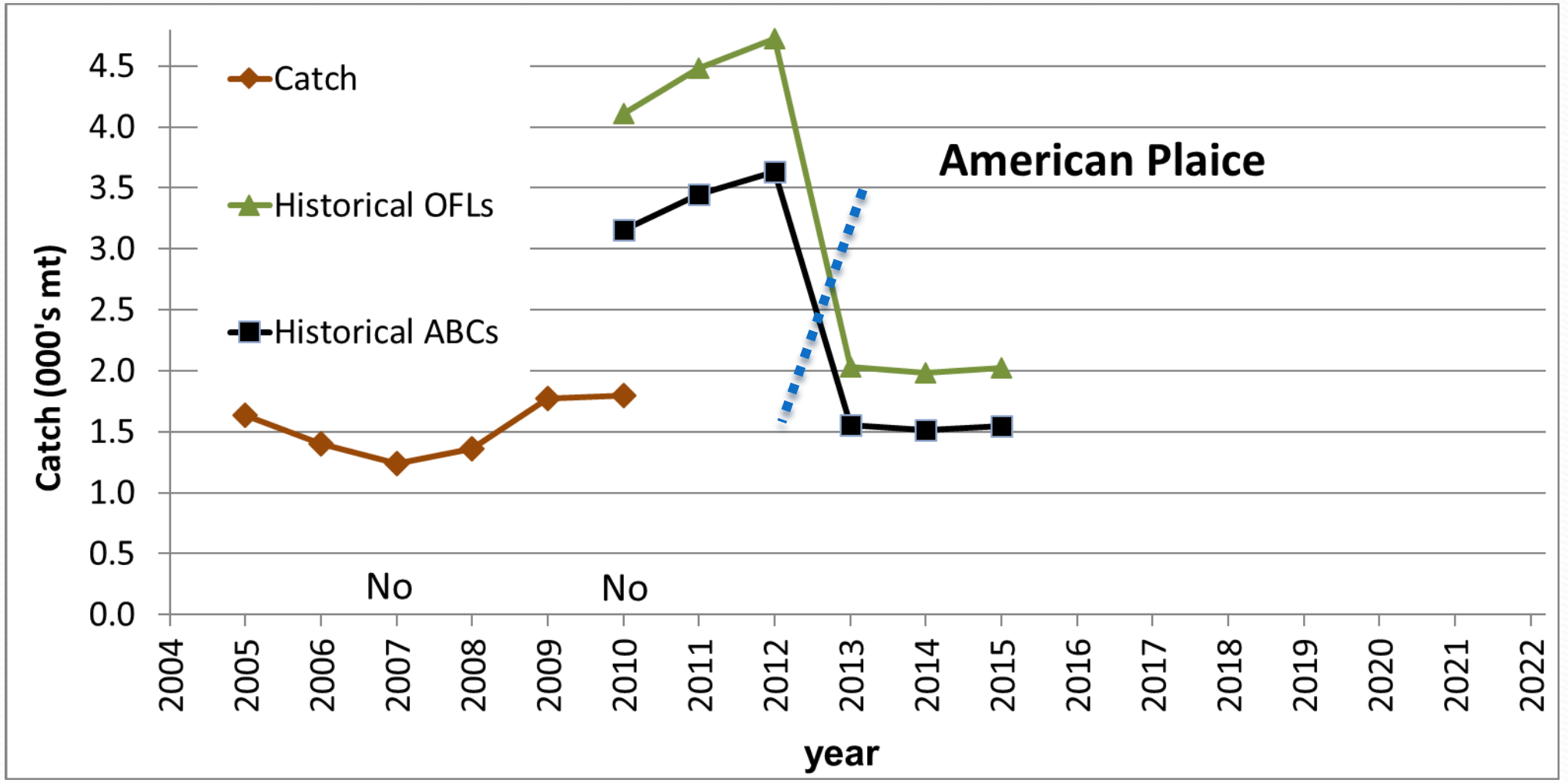

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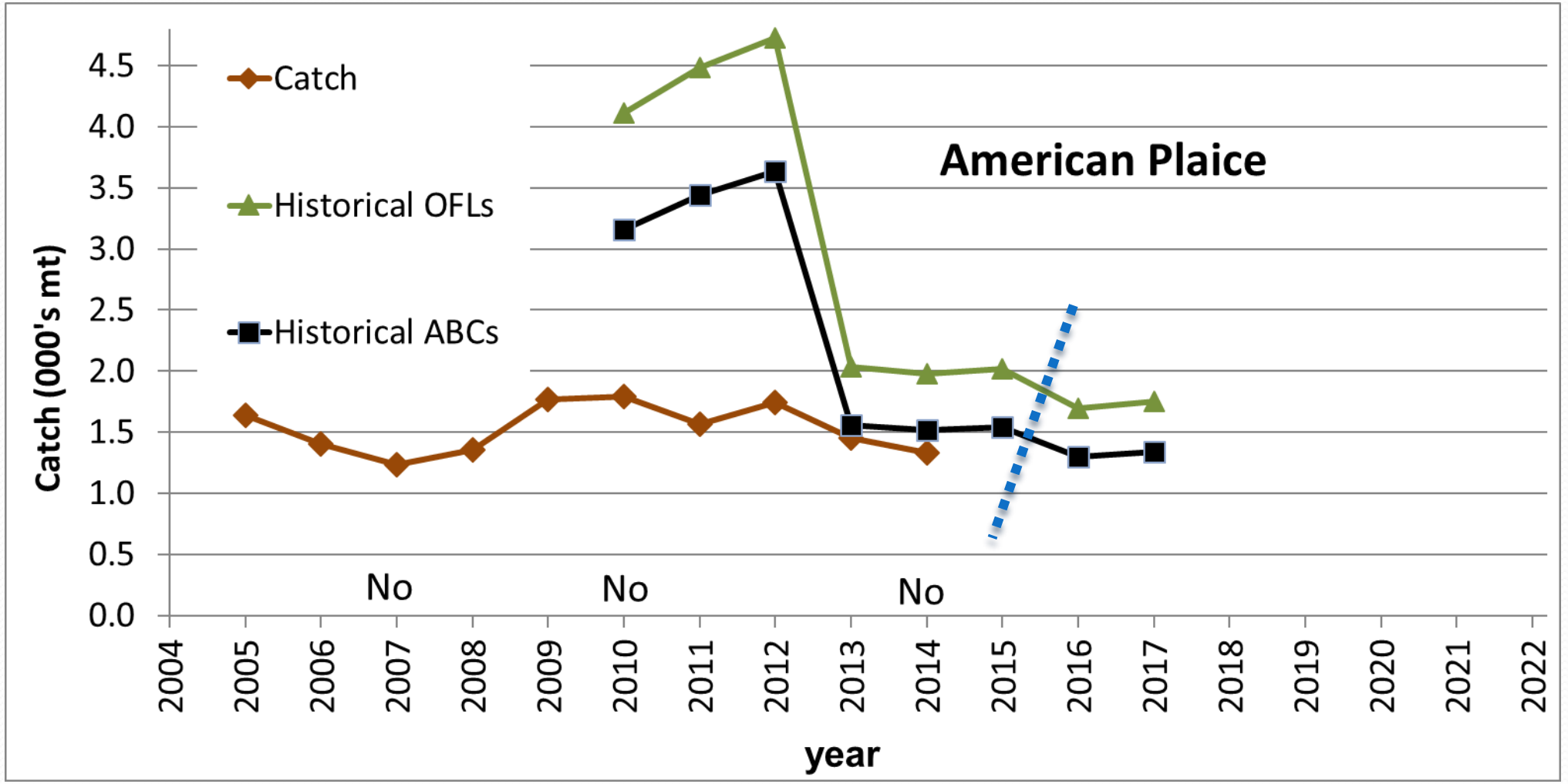

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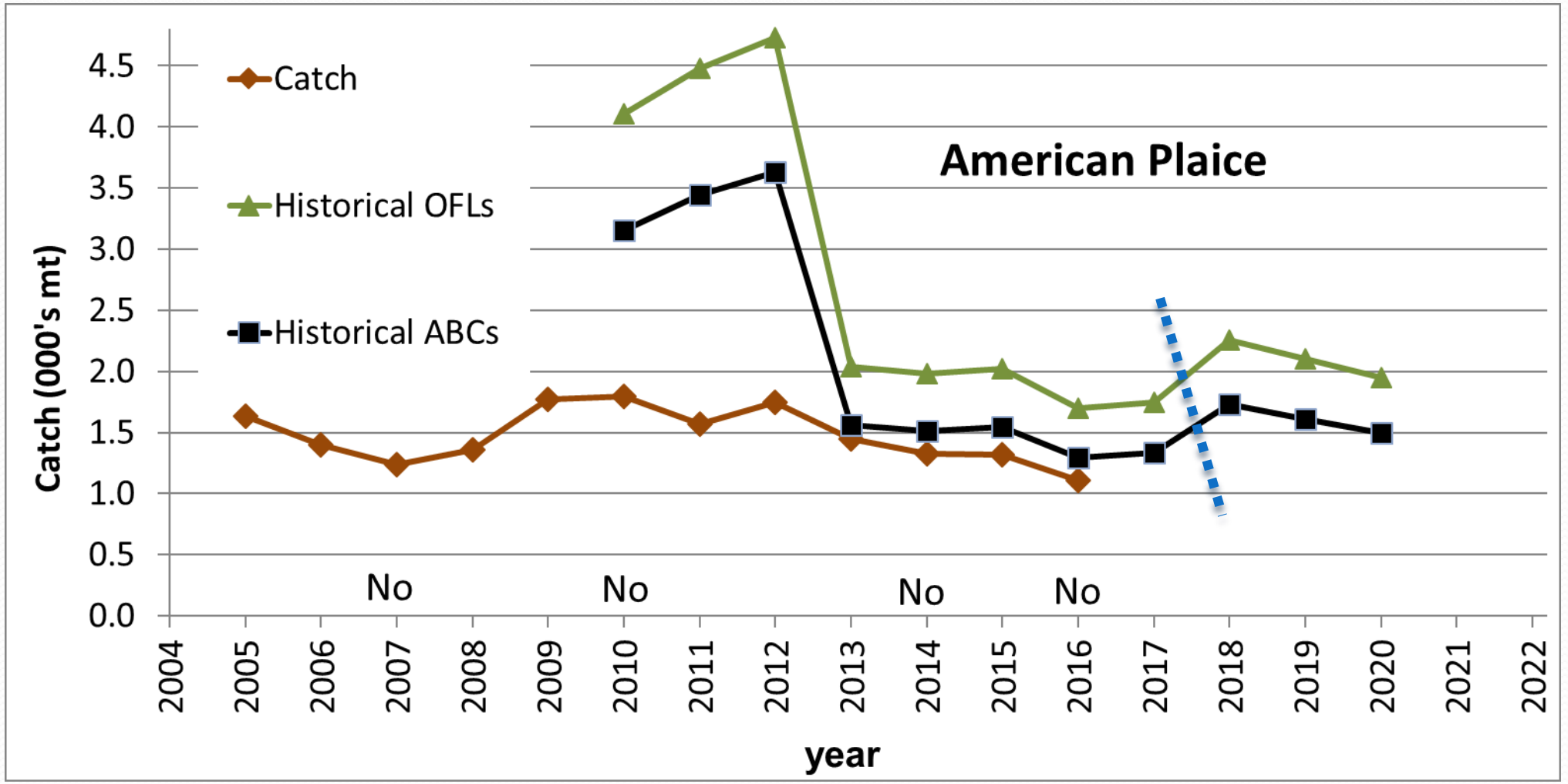

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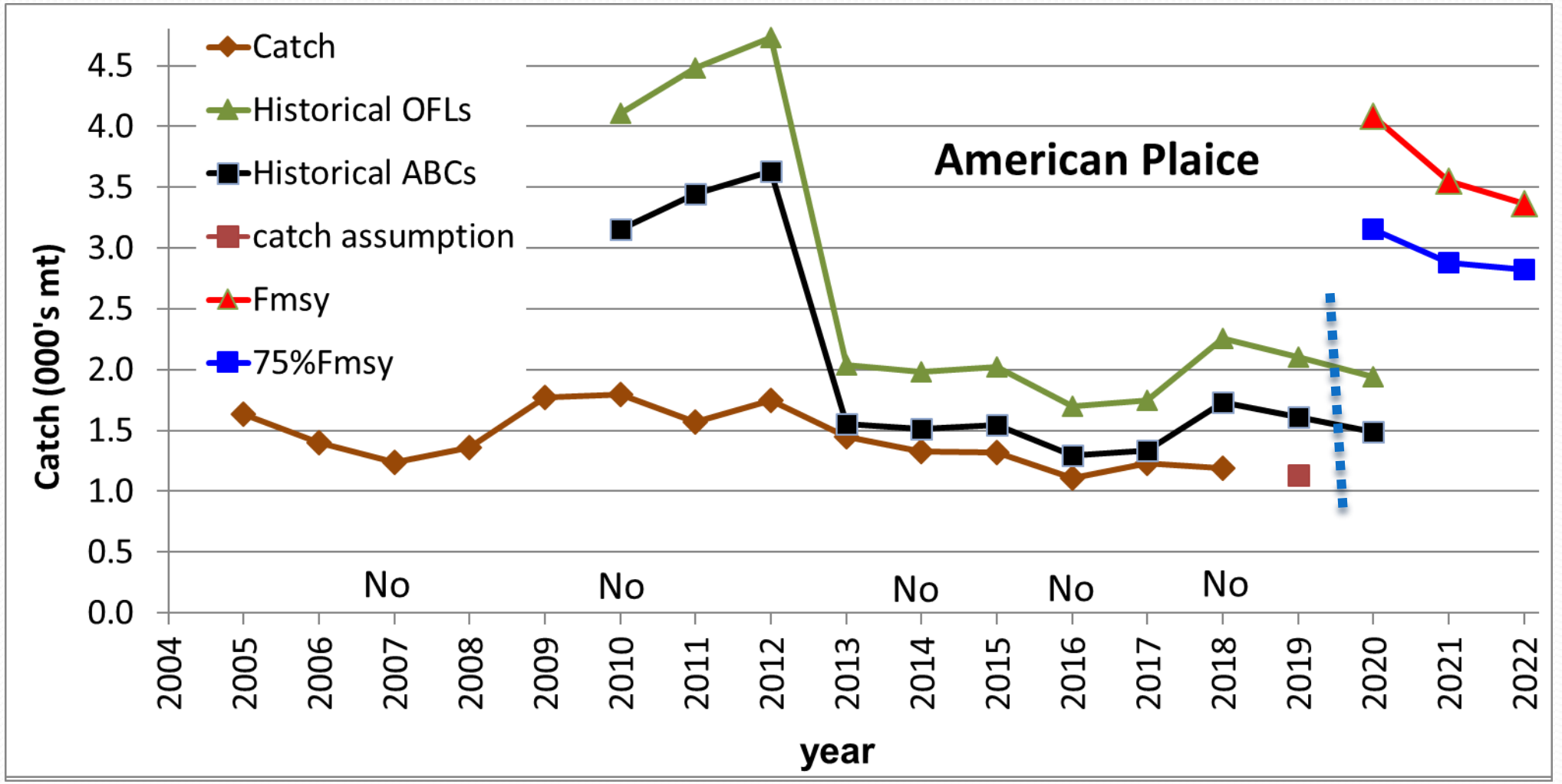


# American Plaice

| Year | Catch | Historical OFLs | Historical ABCs | Catch Assumption | $F_{MSY}$ | 75%$F_{MSY}$ |
|---|---|---|---|---|---|---|
| 2010 | 1,795 | 4,110 | 3,156 | | | |
| 2011 | 1,569 | 4,483 | 3,444 | | | |
| 2012 | 1,747 | 4,727 | 3,632 | | | |
| 2013 | 1,449 | 2,035 | 1,557 | | | |
| 2014 | 1,328 | 1,981 | 1,515 | | | |
| 2015 | 1,316 | 2,021 | 1,544 | | | |
| 2016 | 1,108 | 1,695 | 1,297 | | | |
| 2017 | 1,226 | 1,748 | 1,336 | | | |
| 2018 | 1,192 | 2,260 | 1,732 | | | |
| 2019 | | 2,099 | 1,609 | 1,131 | | |
| 2020 | | 1,945 | 1,492 | | 4,084 | 3,155 |
| 2021 | | | | | 3,547 | 2,881 |
| 2022 | | | | | 3,367 | 2,825 |

# American Plaice

## $75\%F_{MSY}$ Projection

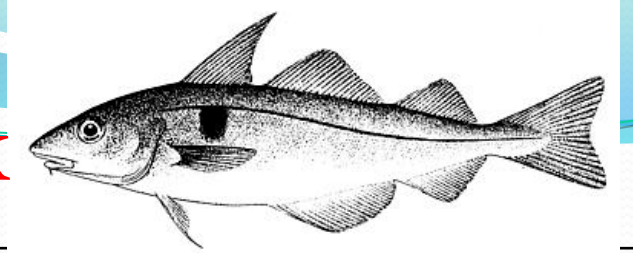
| year | OFL | ABC | F | SSB |
|---|---|---|---|---|
| 2020 | 4,084 | 3,155 | 0.19 | 18,020 |
| 2021 | 3,740 | 2,881 | 0.19 | 16,875 |
| 2022 | 3,687 | 2,825 | 0.19 | 16,911 |

## $75\%F_{MSY}$ Last Year Constant Projection

| year | OFL | ABC | F | SSB |
|---|---|---|---|---|
| 2020 | 4,084 | 2,825 | 0.17 | 18,101 |
| 2021 | 3,806 | 2,825 | 0.19 | 17,202 |
| 2022 | 3,753 | 2,825 | 0.19 | 17,267 |

2,825 mt constant ABC was chosen by the SSC in October
(MSY = 3,301 mt, $75\%F_{MSY}$ = 3,000 mt)

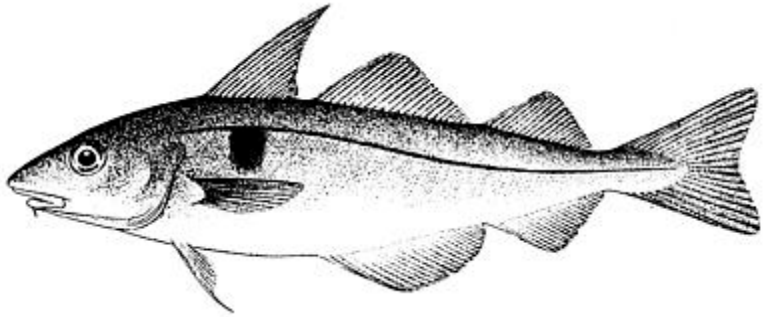
# Georges Bank Haddock



| | |
|---|---|
| ***MODEL*** | VPA (Level 2) |
| ***STOCK STATUS*** | Not Overfished & Overfishing is not occurring |
| ***REBUILDING*** | Rebuilt |
| ***RETROSPECTIVE ADJUSTMENT*** | Yes |
| ***UNCERTAINTIES*** | Retrospective bias, uncertainty with 2013 year class estimate, slower growth with large year classes and selectivity implications |
| ***REVIEWER COMMENTS*** | The largest sources of uncertainty for this stock include the retrospective bias and assumptions in the projections about weights and selectivity at age. Short term projections make adjustments for year class effects. Stock structure assessment implications for the TRAC stock subset assessment verses the whole bank assessment. |

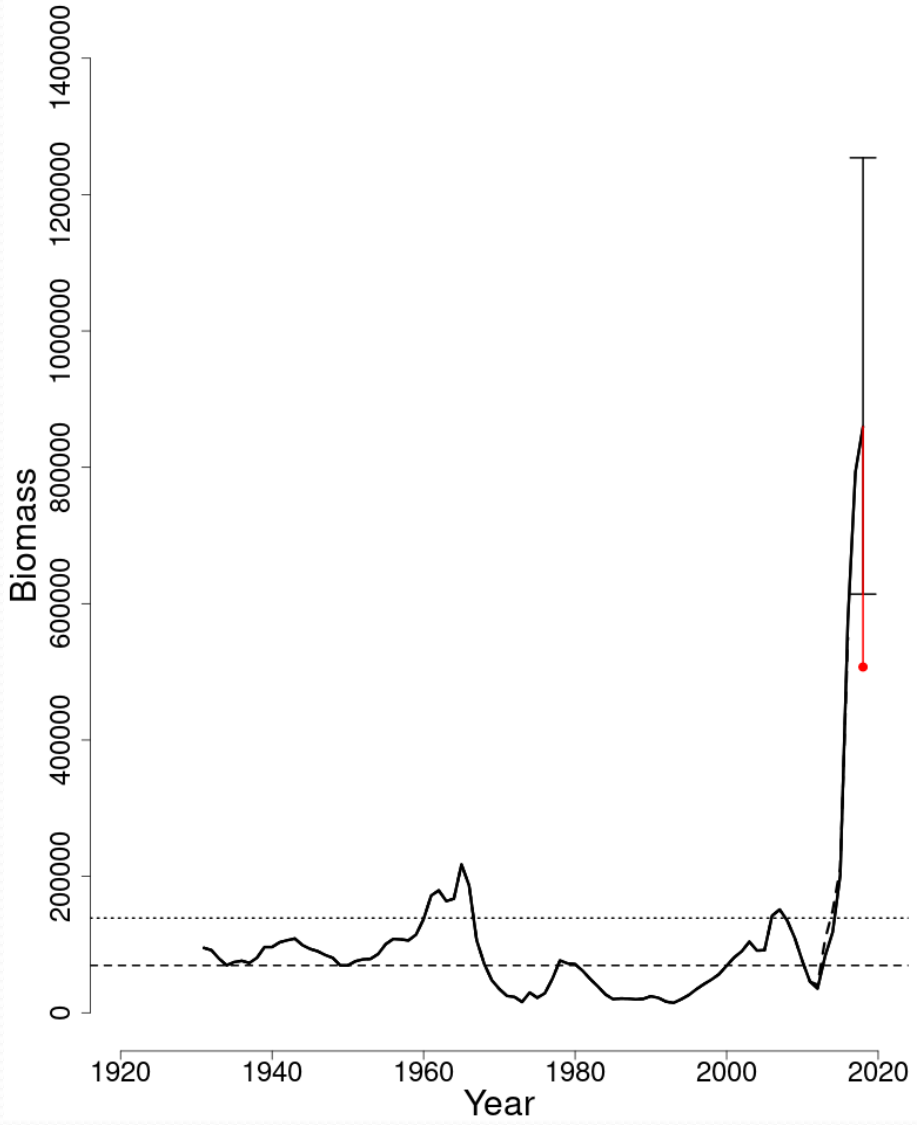
# Georges Bank Haddock

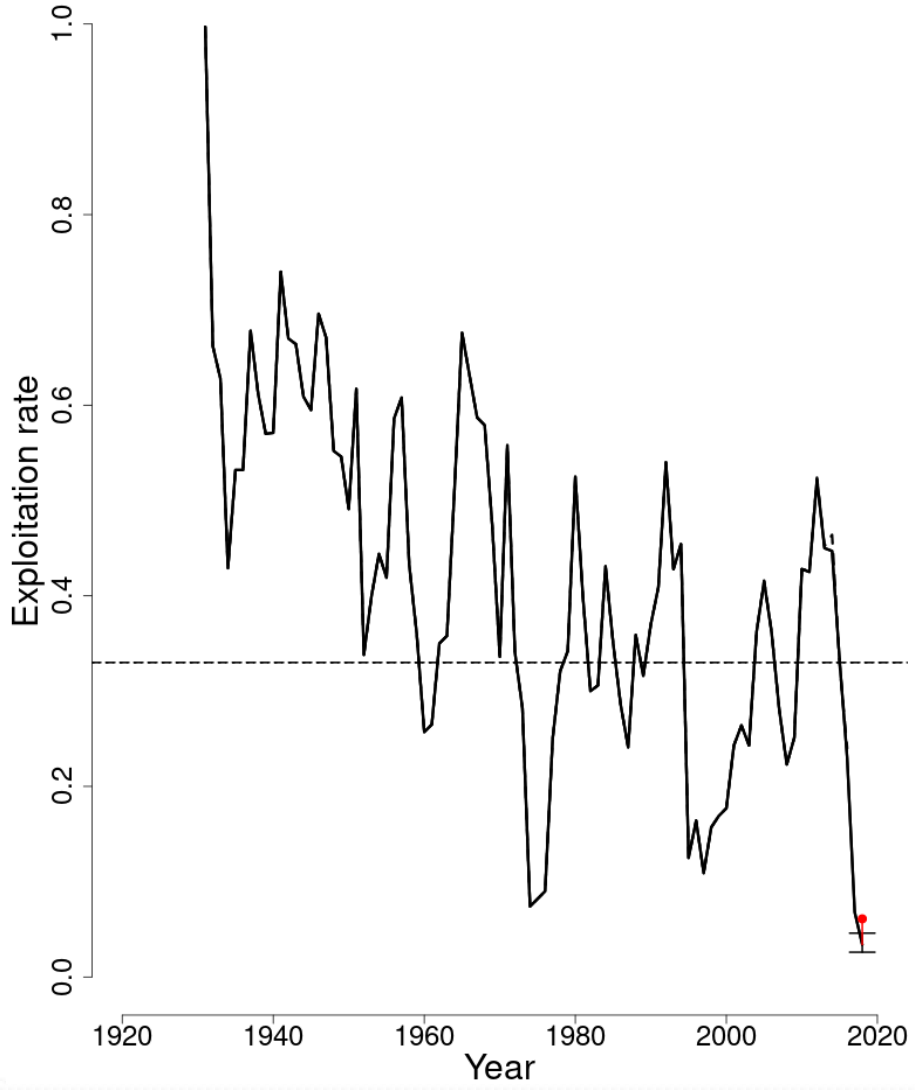
| | 2017 | 2019 |
|---|---|---|
| $F_{MSY}$ *proxy* | 0.35 | 0.33 |
| $SSB_{MSY}$ (mt) | 104,312 | 138,924 (67,347 - 511,852) |
| MSY (mt) | 24,400 | 30,489 (14,894 - 111,258) |
| Median recruits (age 1) (000s) | 52,249 | 59,143 (2,780 - 394,017) |
| *Overfishing* | No | No |
| *Overfished* | No | No |



$SSB/SSB_{MSY} = 3.65$ and $F/F_{MSY} = 0.18$

# Georges Bank Haddock



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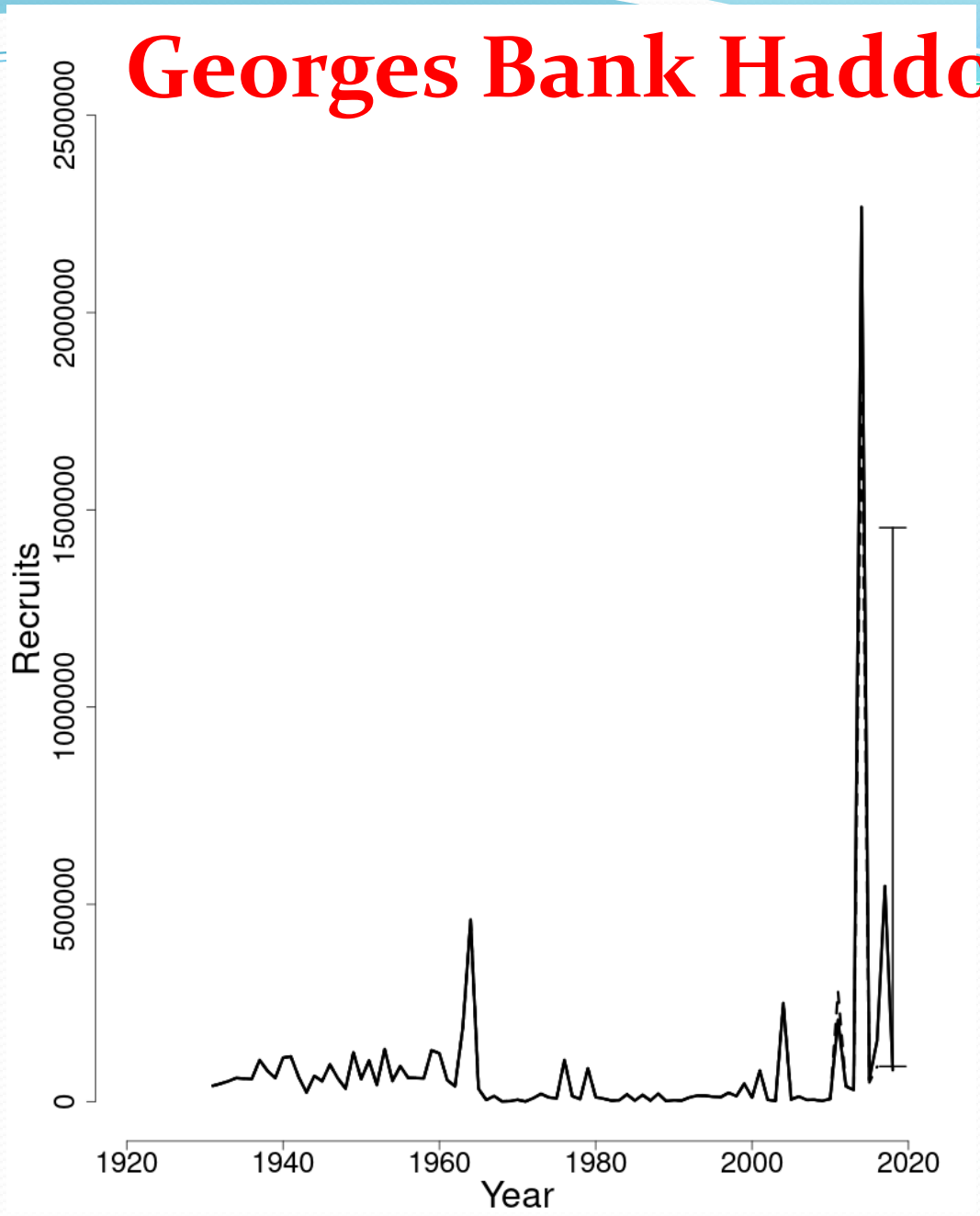

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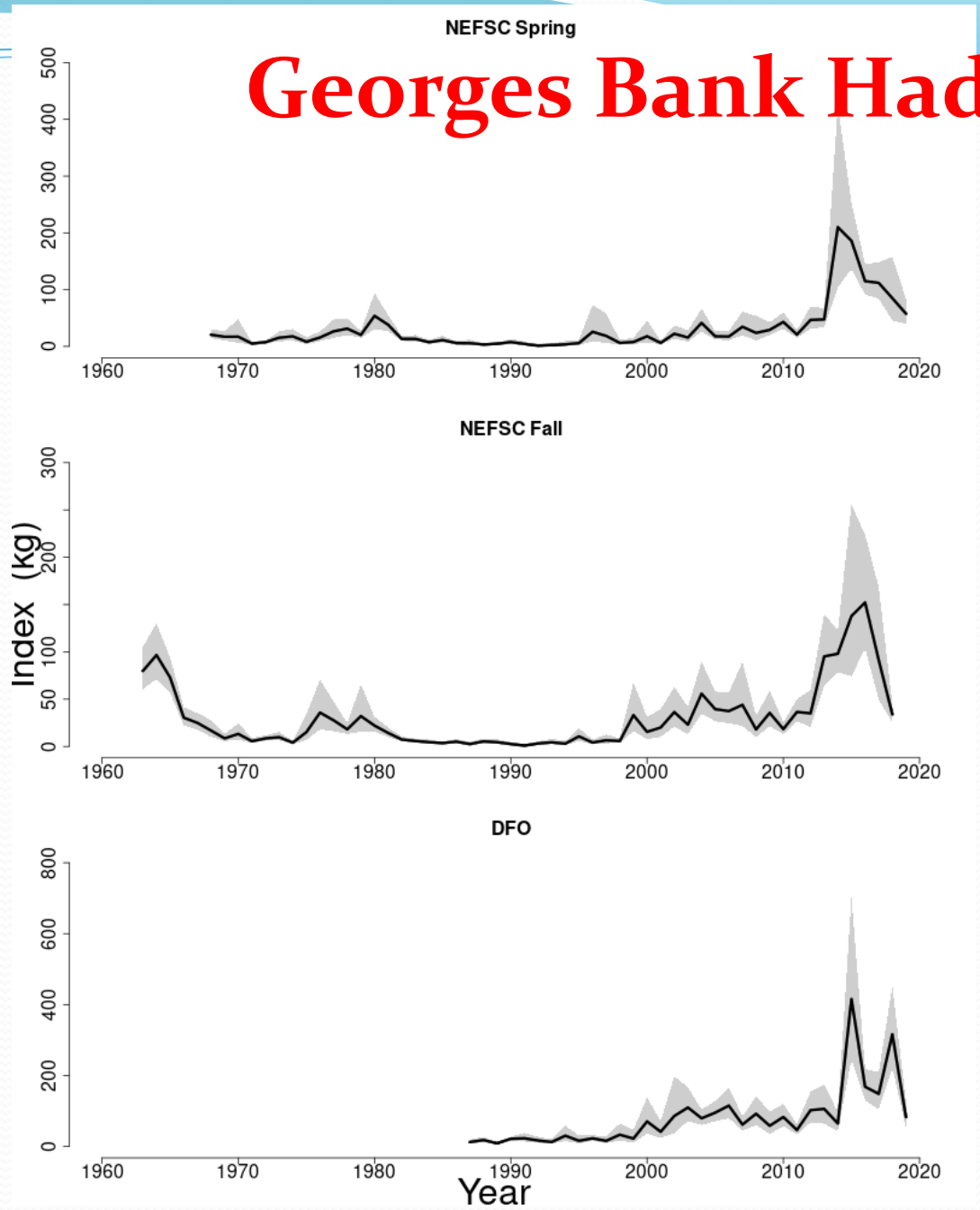

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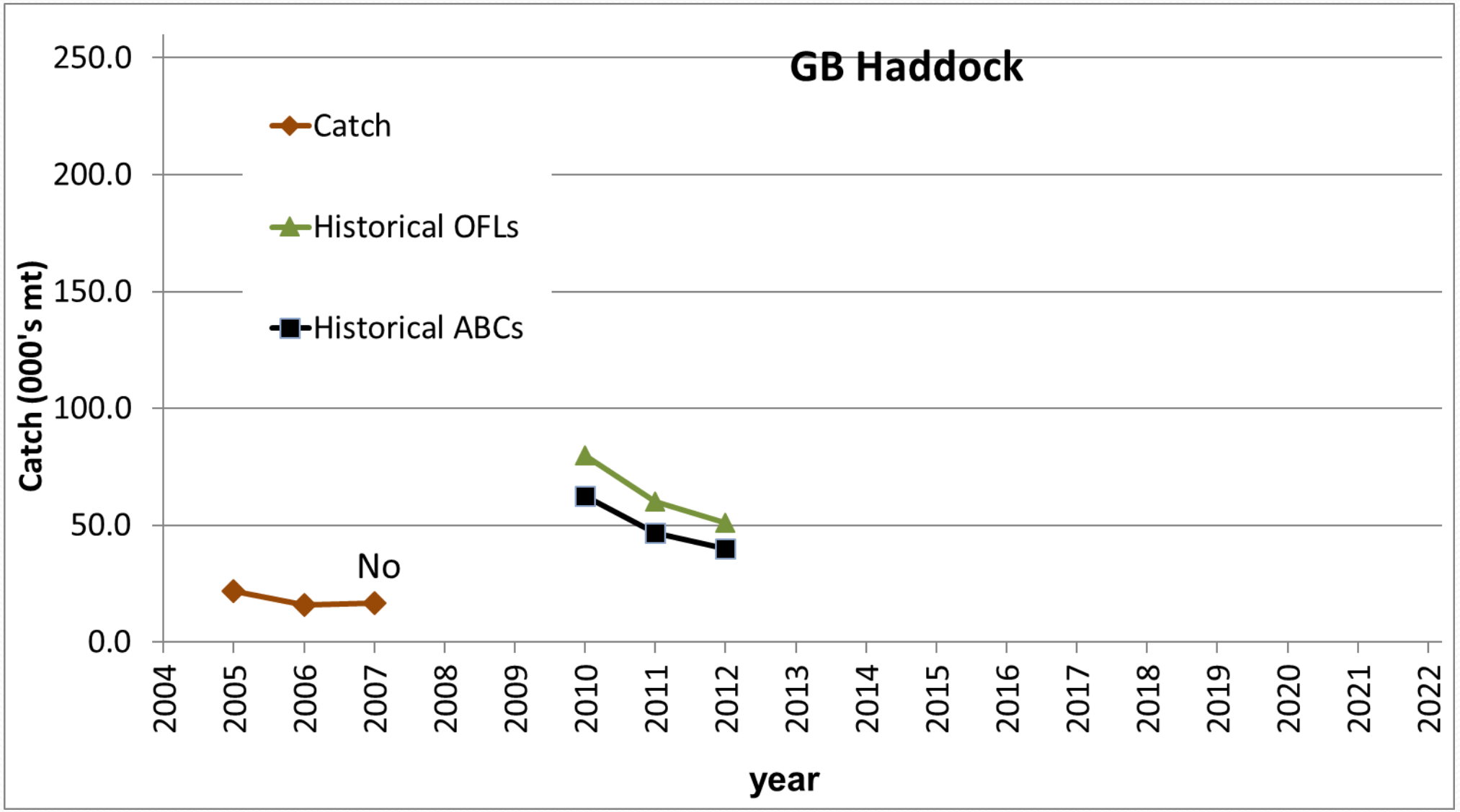

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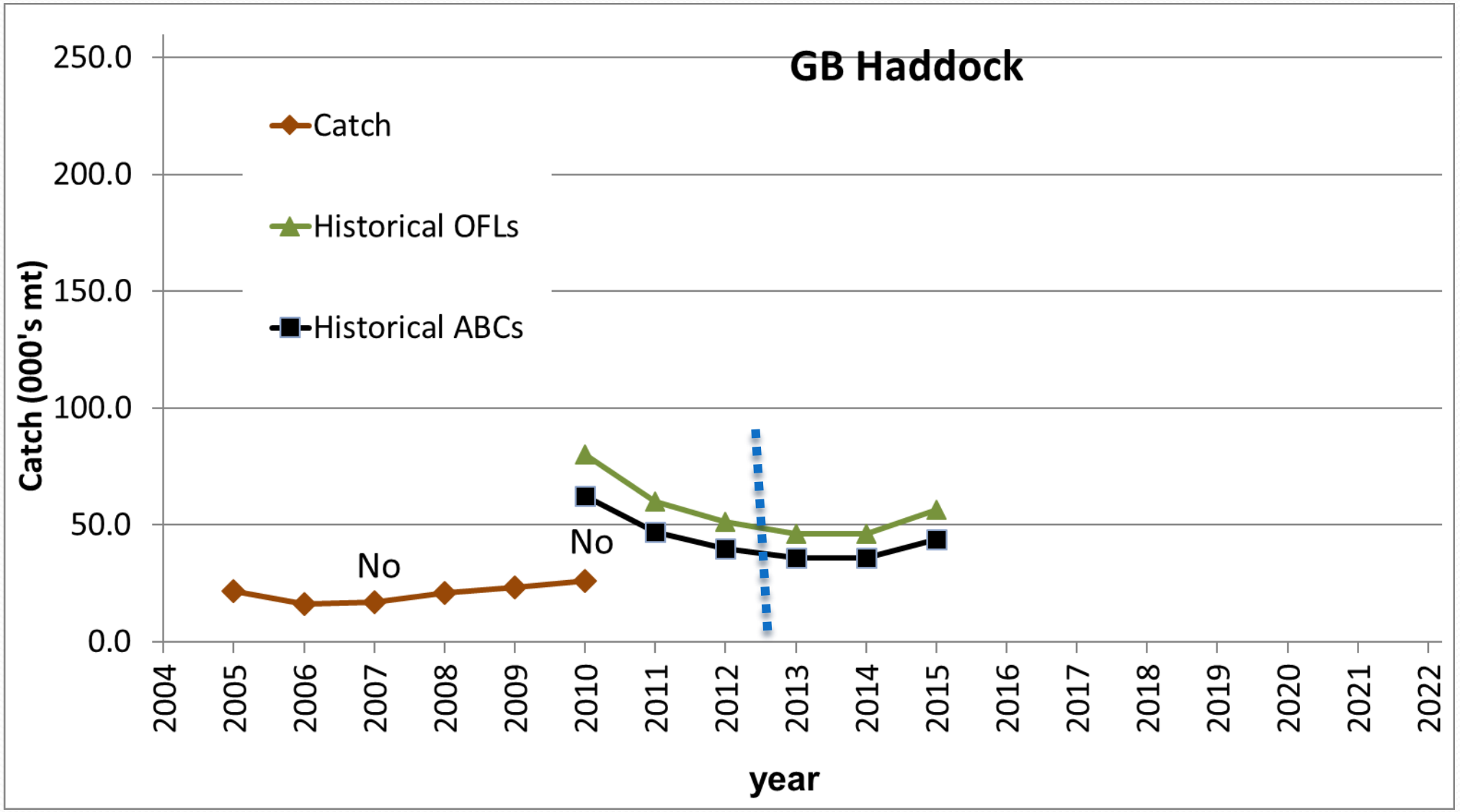

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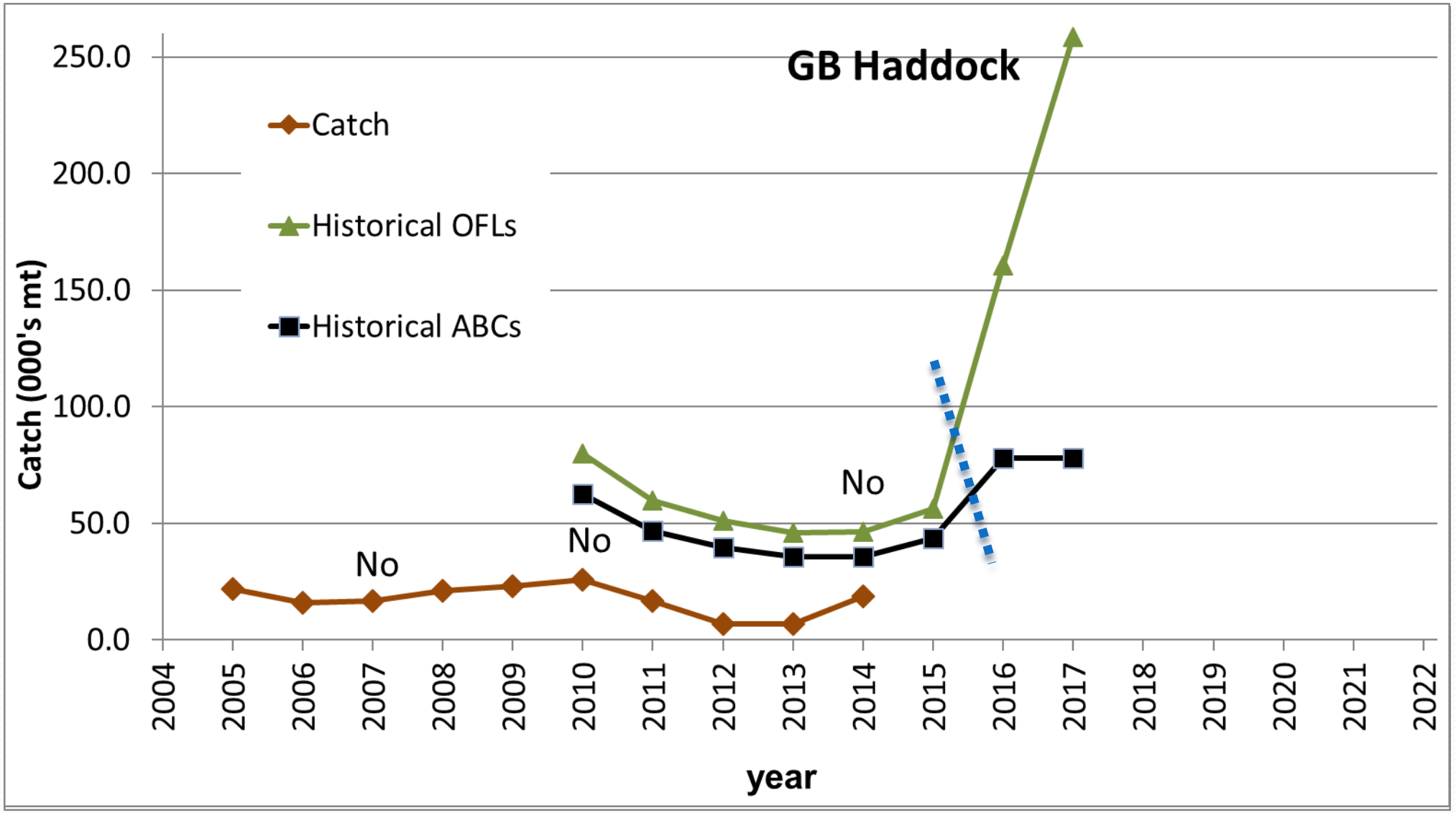

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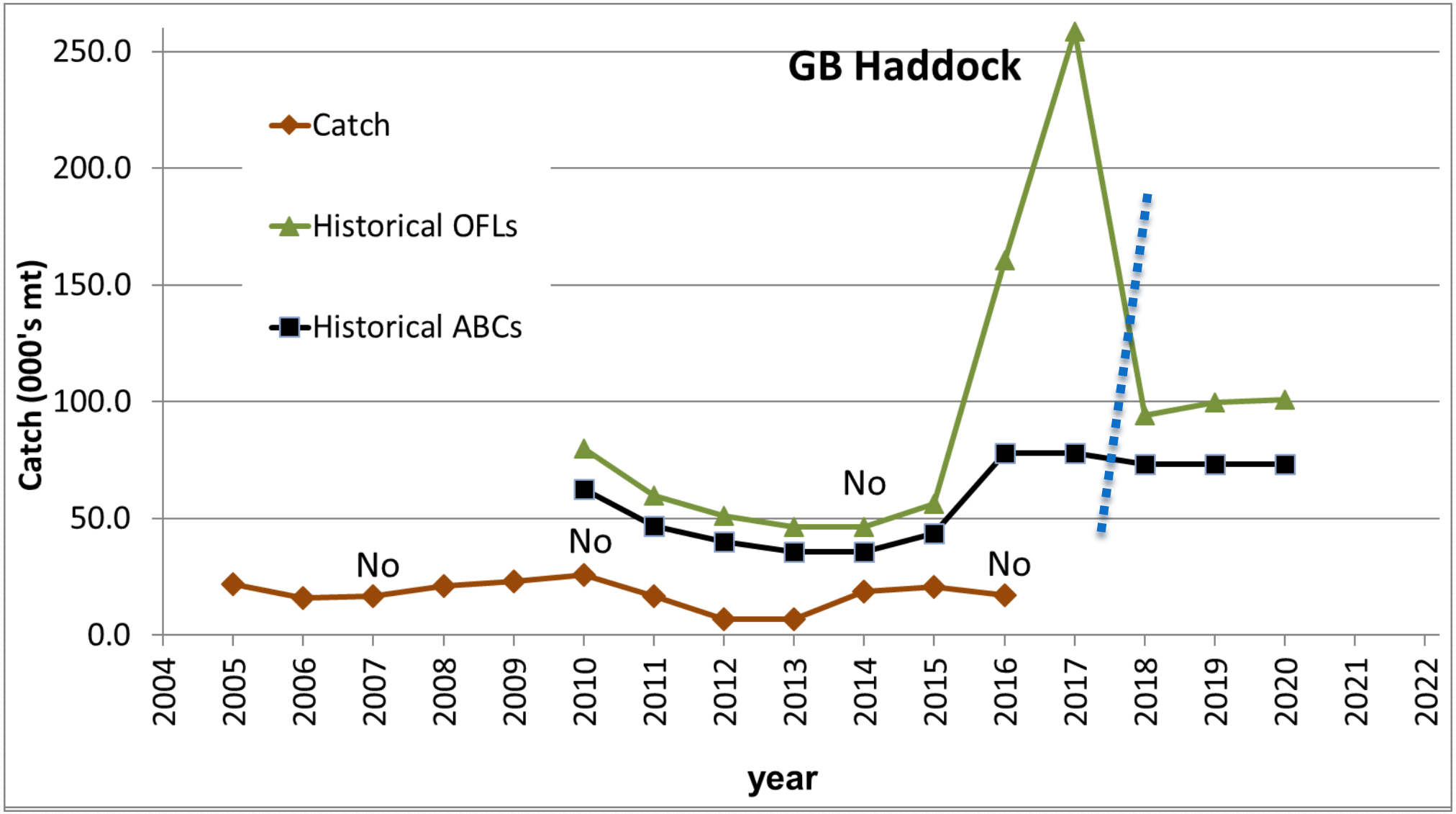

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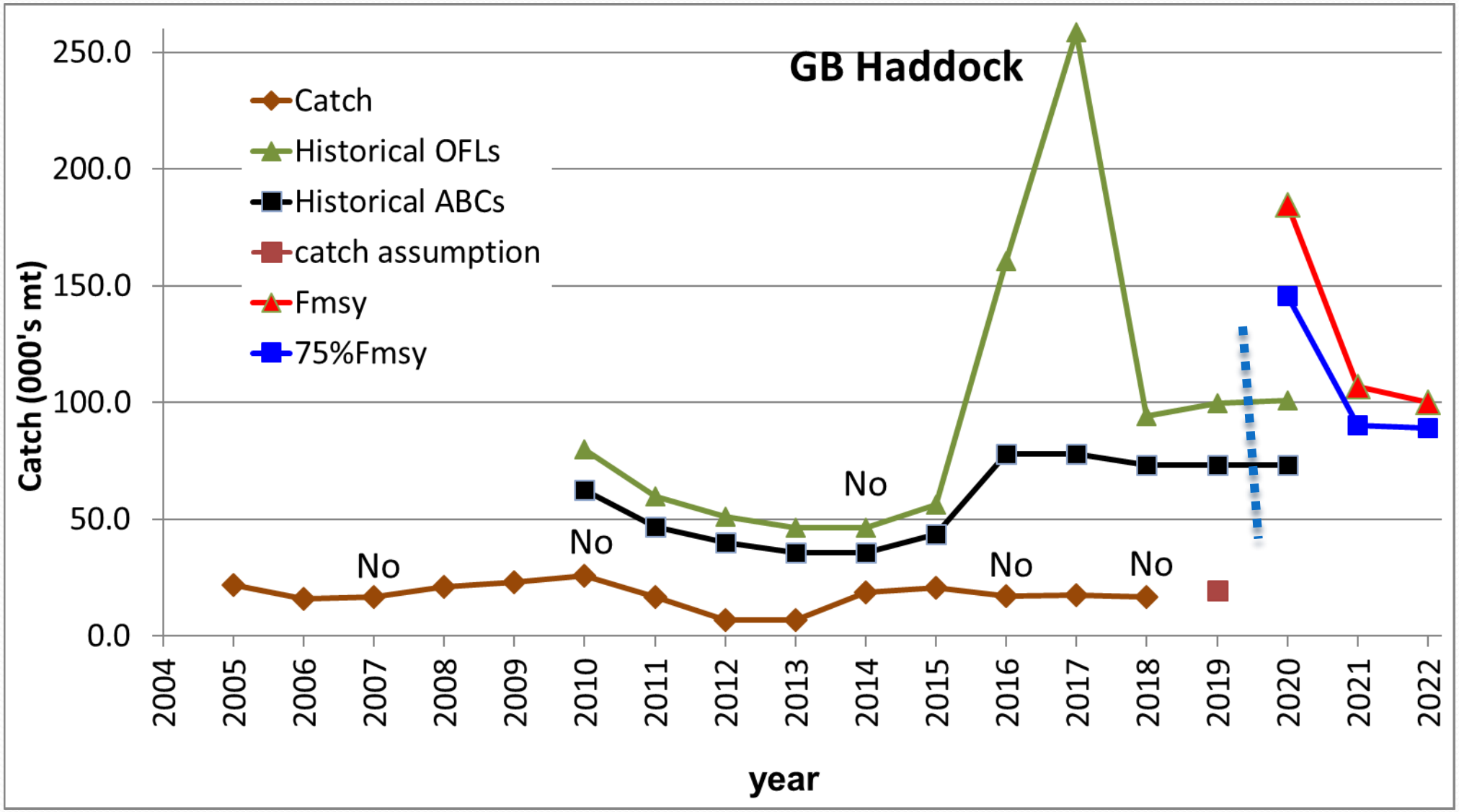


# Georges Bank Haddock

| Year | Catch | Historical OFLs | Historical ABCs | Catch Assumption | $F_{MSY}$ | $75\%F_{MSY}$ |
|---|---|---|---|---|---|---|
| 2010 | 25,903 | 80,007 | 62,515 | | | |
| 2011 | 16,670 | 59,948 | 46,784 | | | |
| 2012 | 6,935 | 51,150 | 39,846 | | | |
| 2013 | 6,828 | 46,185 | 35,783 | | | |
| 2014 | 18,601 | 46,268 | 35,699 | | | |
| 2015 | 20,687 | 56,293 | 43,606 | | | |
| 2016 | 17,274 | 160,385 | 77,898 | | | |
| 2017 | 17,387 | 258,691 | 77,898 | | | |
| 2018 | 16,647 | 94,274 | 73,114 | | | |
| 2019 | | 99,757 | 73,114 | 19,455 | | |
| 2020 | | 100,825 | 73,114 | | 184,822 | 145,367 |
| 2021 | | | | | 106,805 | 90,337 |
| 2022 | | | | | 100,009 | 88,856 |

# Georges Bank Haddock

## $75\%F_{MSY}$ Projection

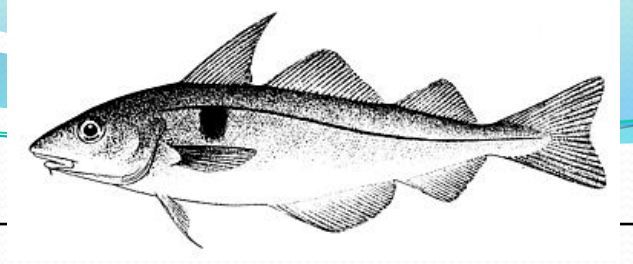
| year | OFL | ABC | F | SSB |
|---|---|---|---|---|
| 2020 | 184,822 | 145,367 | 0.36 | 594,412 |
| 2021 | 116,883 | 90,337 | 0.36 | 549,918 |
| 2022 | 114,925 | 88,856 | 0.36 | 470,979 |

## $75\%F_{MSY}$ Last Year Constant Projection

| year | OFL | ABC | F | SSB |
|---|---|---|---|---|
| 2020 | 184,822 | 88,856 | 0.21 | 611,549 |
| 2021 | 130,773 | 88,856 | 0.31 | 611,849 |
| 2022 | 129,580 | 88,856 | 0.31 | 532,886 |

88,856 mt constant ABC was chosen by the SSC in October (MSY = 59,143 mt)

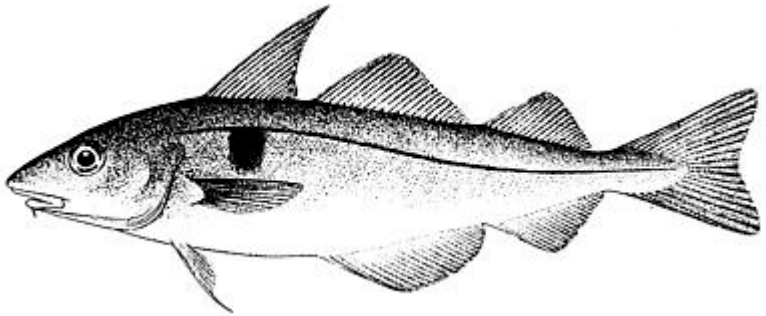
# Gulf of Maine Haddock



| | |
|---|---|
| ***MODEL*** | ASAP (Level 2) |
| ***STOCK STATUS*** | Not Overfished & Overfishing is not occurring |
| ***REBUILDING*** | Rebuilt |
| ***RETROSPECTIVE ADJUSTMENT*** | Yes (increase adjustment) |
| ***UNCERTAINTIES*** | retrospective error |
| ***REVIEWER COMMENTS*** | Panel found it appropriate to make adjustments to account for the retrospective pattern as a matter of protocol. The Panel suggests that the PDT present both retrospective adjusted and unadjusted projections to the SSC to demonstrate the impact of this decision. |
| ***CHANGES*** | New MRIP time series is incorporated in the model. |

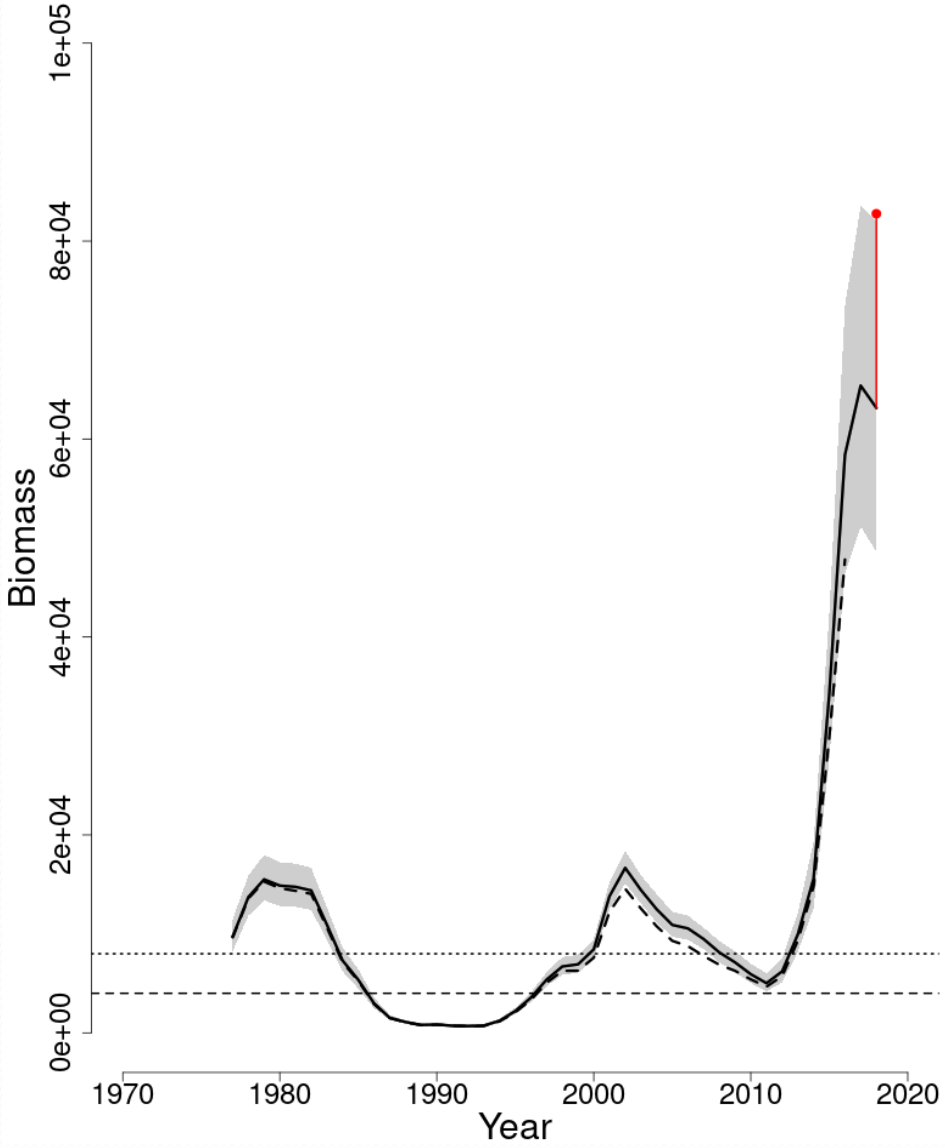
# Gulf of Maine Haddock

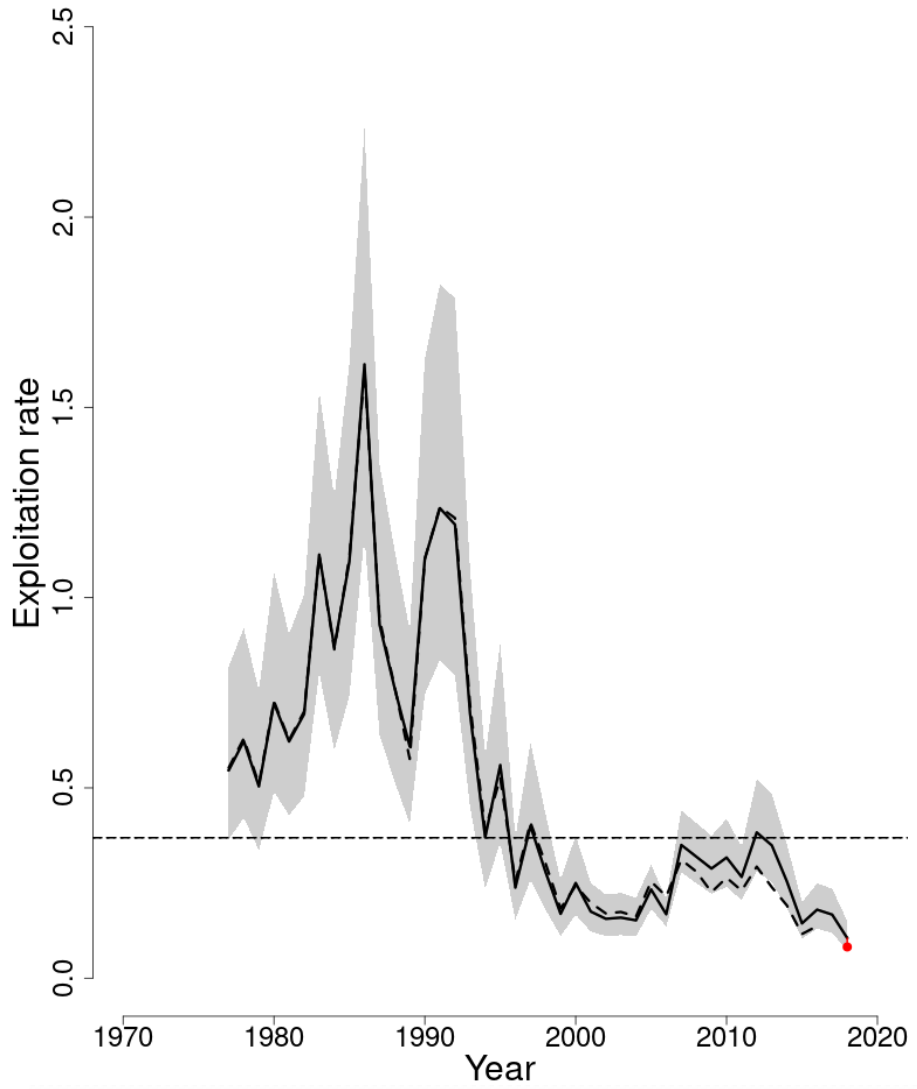
| | 2017 | 2019 |
|---|---|---|
| $F_{MSY}$ *proxy* | 0.455 (0.380 - 0.538) | 0.369 (0.307 - 0.447) |
| $SSB_{MSY}$ (mt) | 6,769 (2,525 - 27,545) | 7,993 (3,218 - 34,191) |
| MSY (mt) | 1,547 (584 - 6,160) | 1,597 (651 - 6,797) |
| Median recruits (age 1) (000s) | 1,498 (275 - 17,307) | 1,789 (285 - 17,883) |
| *Overfishing* | No | No |
| *Overfished* | No | No |



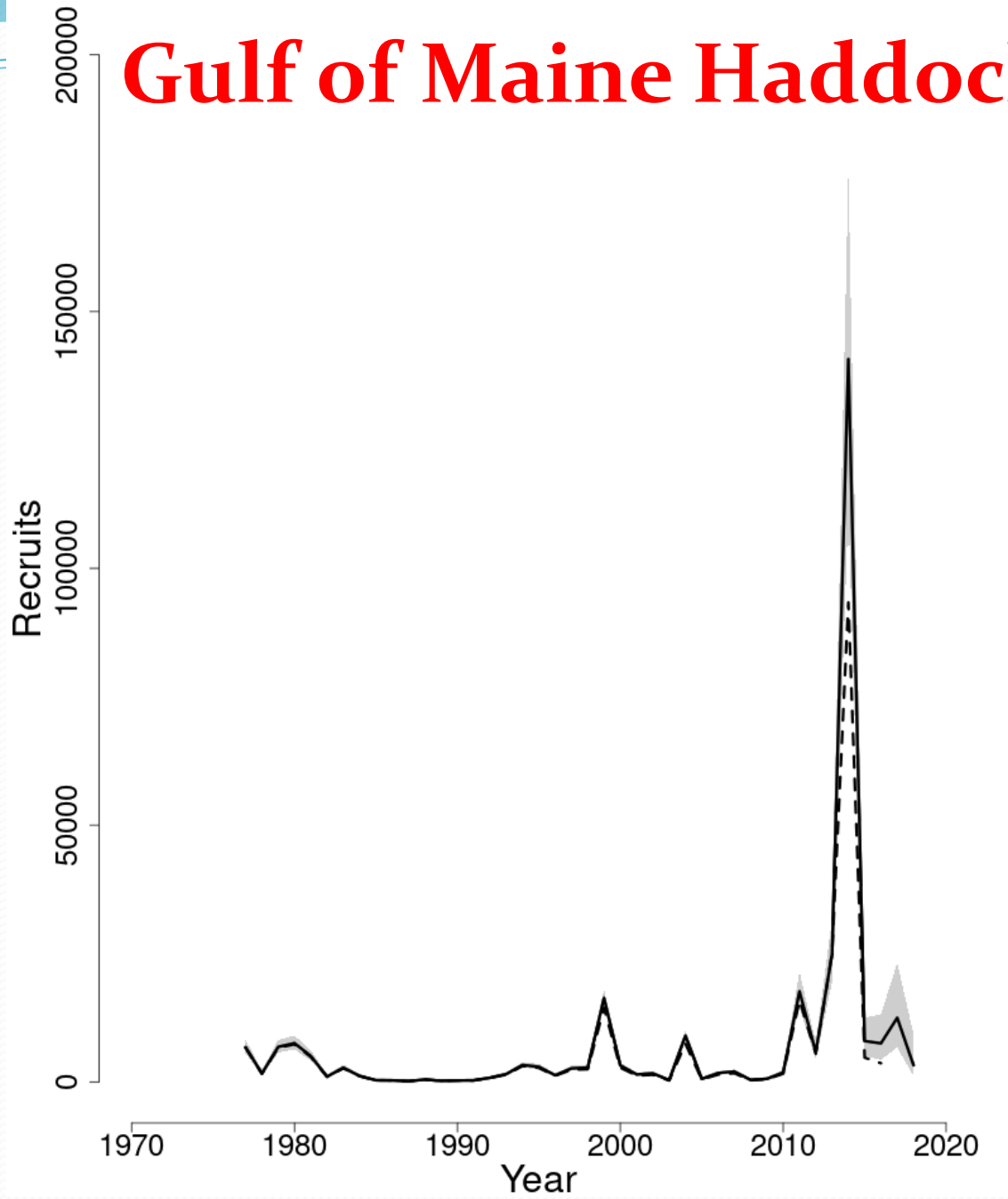
$SSB/SSB_{MSY} = 10.35$ and $F/F_{MSY} = 0.22$

# Gulf of Maine Haddock

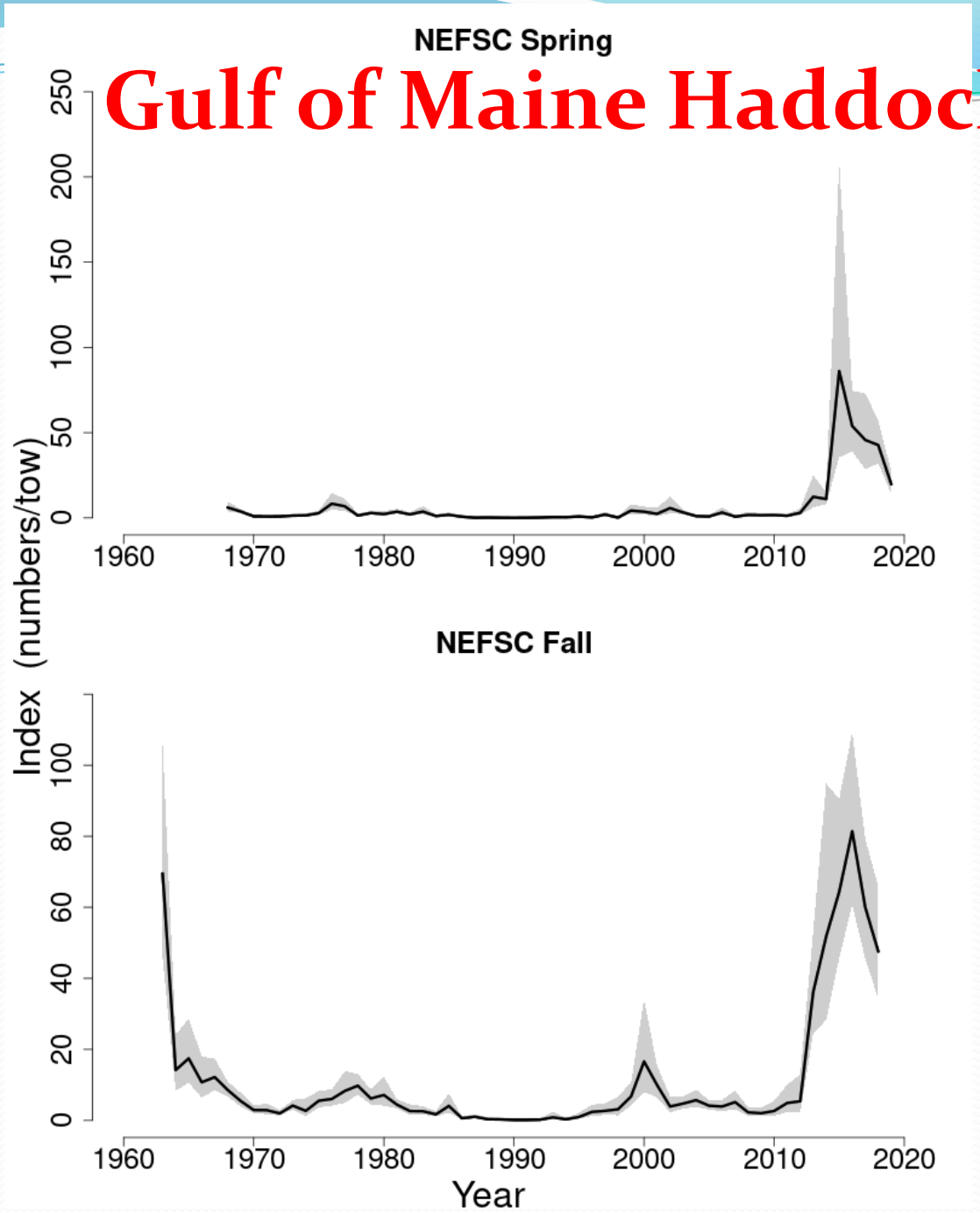


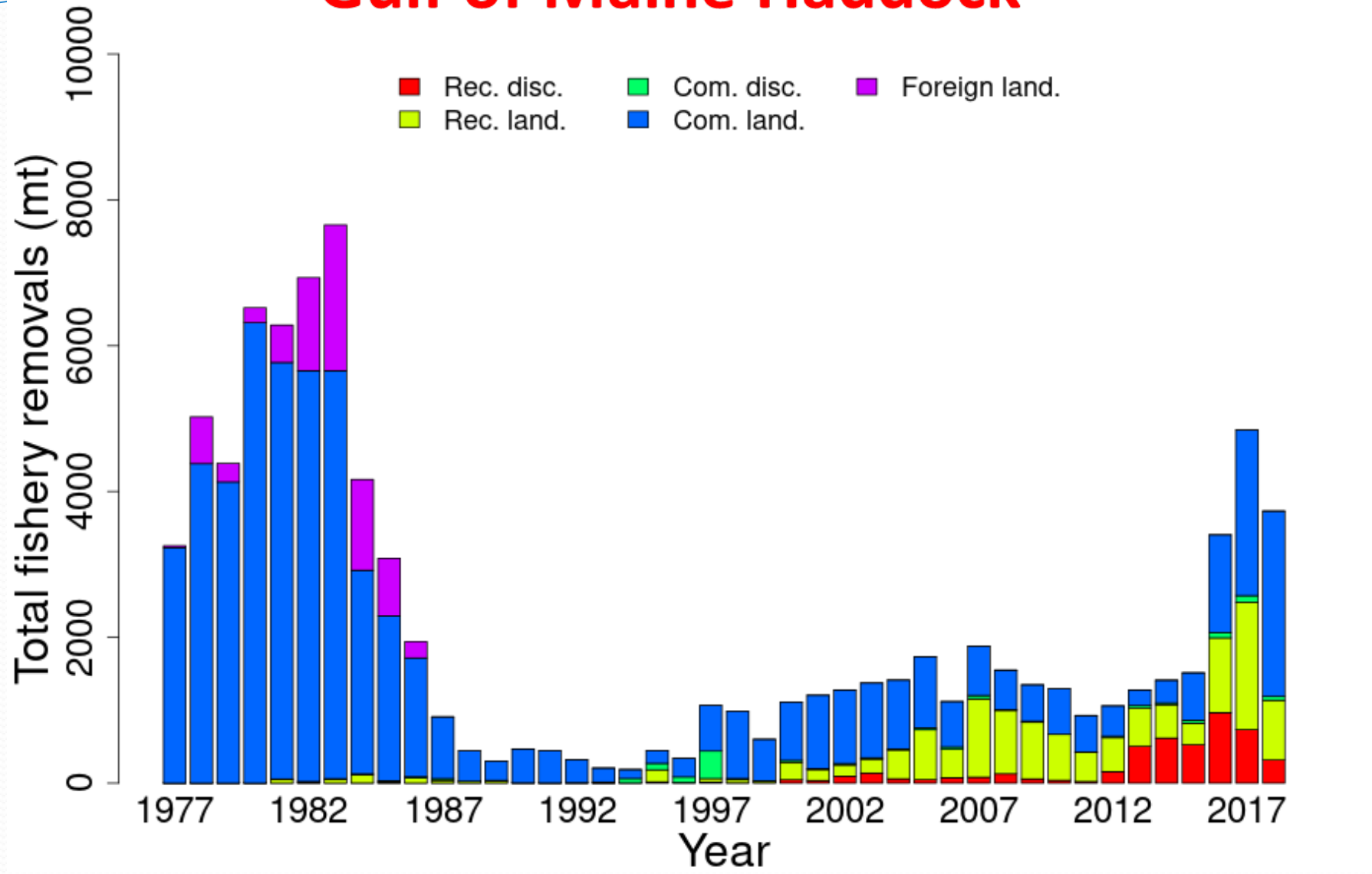
# Gulf of Maine Haddock



# Gulf of Maine Haddock



# Gulf of Maine Haddock

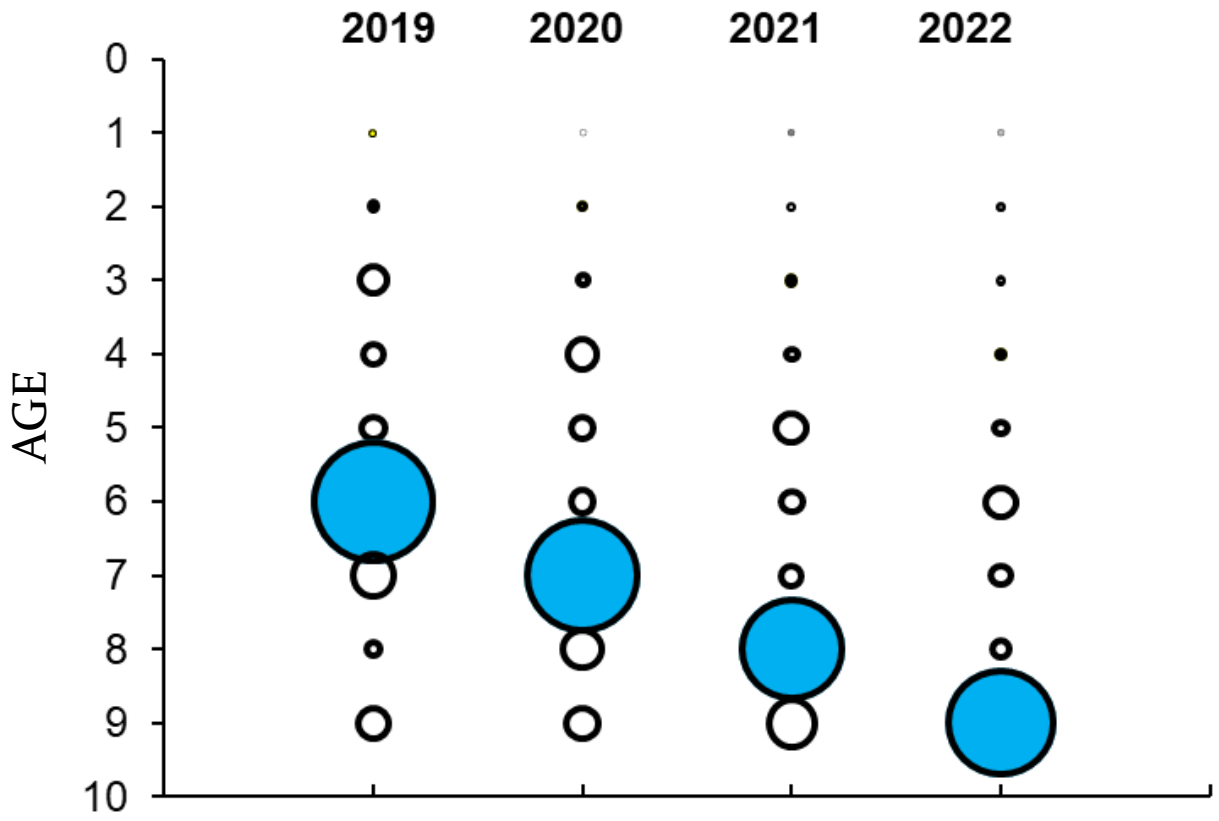


# Gulf of Maine Haddock

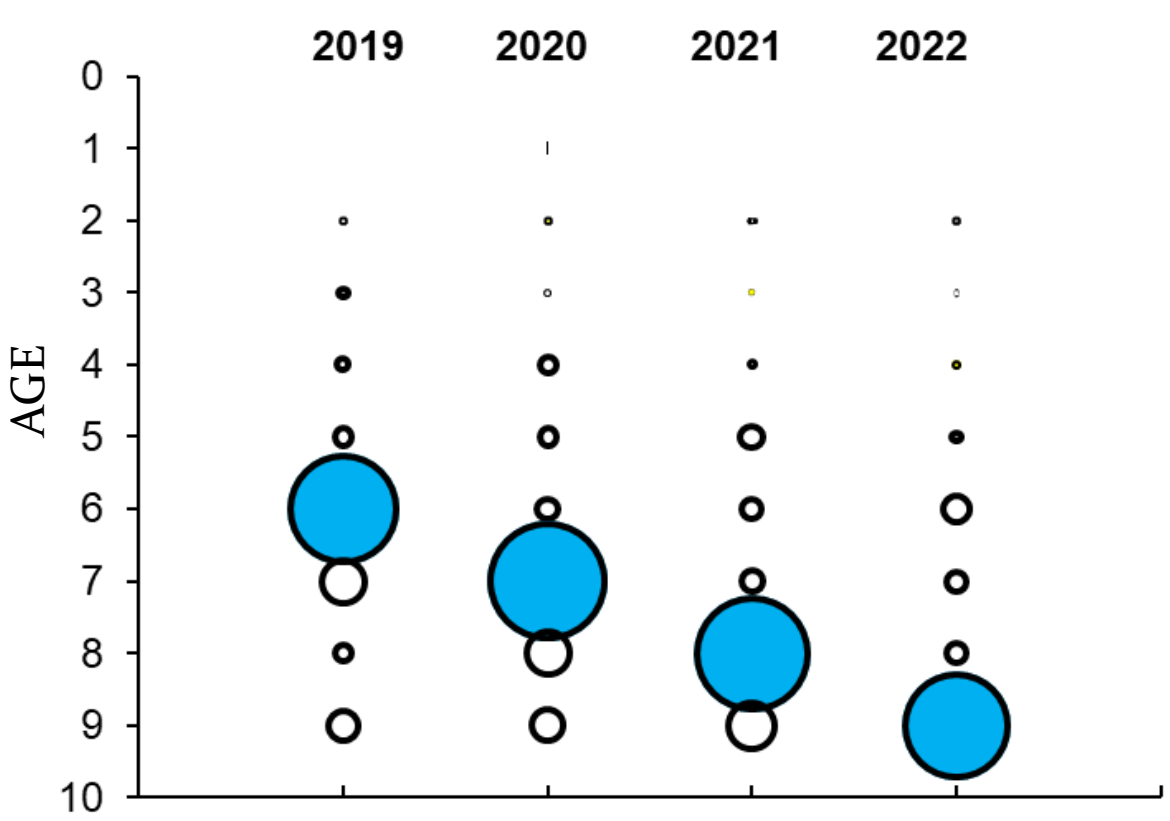
| Age | stock wt | selectivity | maturity |
|---|---|---|---|
| 1 | 0.13 | 0.00 | 0.05 |
| 2 | 0.32 | 0.05 | 0.32 |
| 3 | 0.55 | 0.18 | 0.81 |
| 4 | 0.78 | 0.34 | 0.98 |
| 5 | 1.06 | 0.53 | 1.00 |
| 6 | 1.33 | 0.69 | 1.00 |
| 7 | 1.54 | 0.87 | 1.00 |
| 8 | 1.74 | 1.00 | 1.00 |
| 9+ | 2.25 | 0.79 | 1.00 |

# Gulf of Maine Haddock

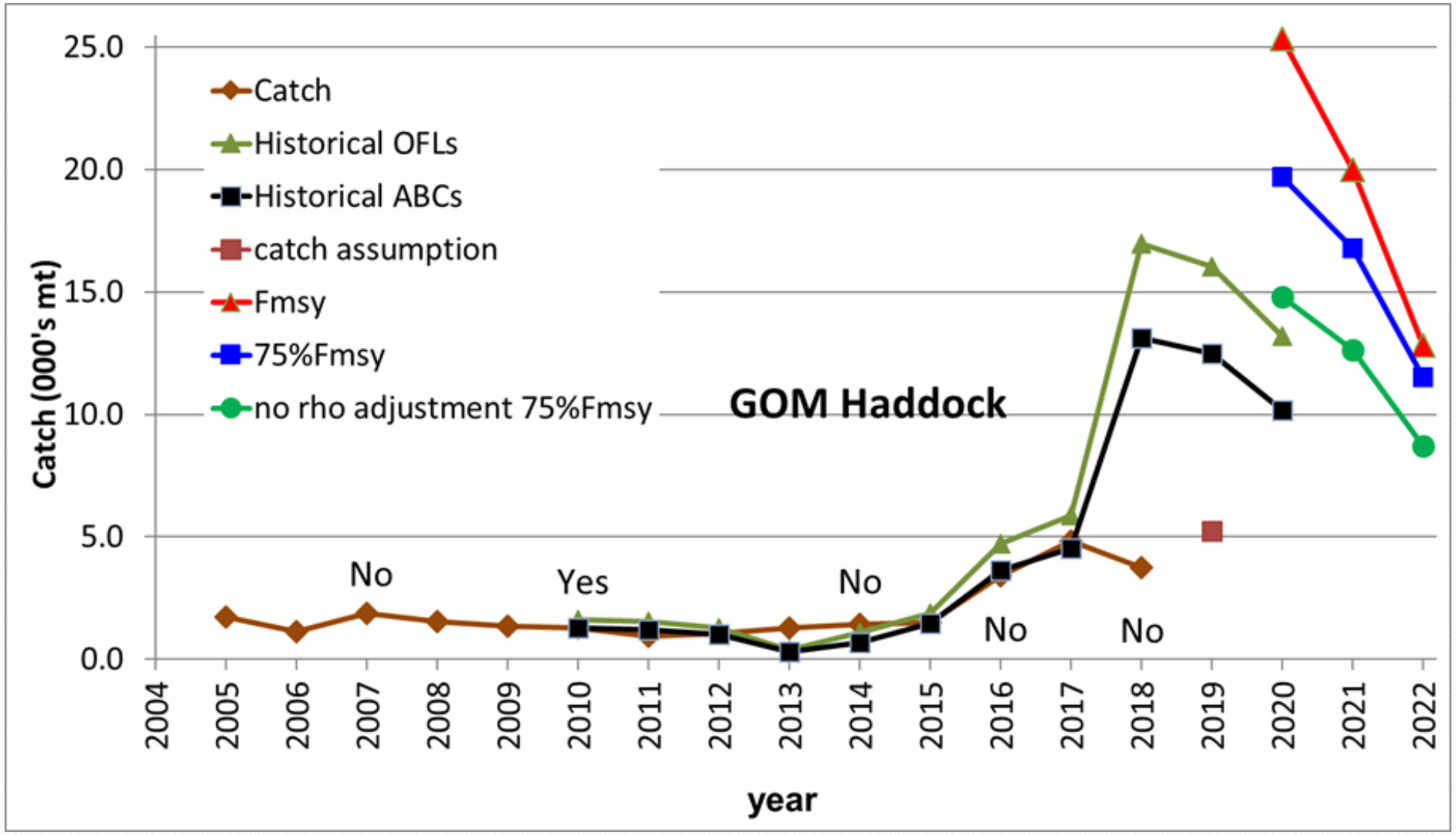
Stock Biomass




Exploitable Biomass



# Gulf of Maine Haddock



# Gulf of Maine Haddock

| Year | Catch | Historical OFLs | Historical ABCs | Catch Assumption | $F_{MSY}$ | $75\%F_{MSY}$ | no rho adj $75\%F_{MSY}$ |
|---|---|---|---|---|---|---|---|
| 2010 | 1,295 | 1,617 | 1,265 | | | | |
| 2011 | 926 | 1,536 | 1,206 | | | | |
| 2012 | 1,060 | 1,296 | 1,013 | | | | |
| 2013 | 1,277 | 371 | 290 | | | | |
| 2014 | 1,412 | 1,085 | 677 | | | | |
| 2015 | 1,513 | 1,871 | 1,454 | | | | |
| 2016 | 3,406 | 4,717 | 3,630 | | | | |
| 2017 | 4,843 | 5,873 | 4,534 | | | | |
| 2018 | 3,731 | 16,954 | 13,131 | | | | |
| 2019 | | 16,038 | 12,490 | 5,239 | | | |
| 2020 | | 13,200 | 10,186 | | 25,334 | 19,696 | 14,800 |
| 2021 | | | | | 19,996 | 16,794 | 12,634 |
| 2022 | | | | | 12,811 | 11,526 | 8,700 |

# Gulf of Maine Haddock

## $75\%F_{MSY}$ Projection

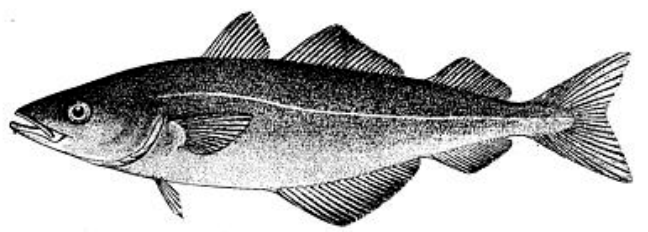
| year | OFL | ABC | F | SSB |
|---|---|---|---|---|
| 2020 | 25,334 | 19,696 | 0.28 | 94,793 |
| 2021 | 21,521 | 16,794 | 0.28 | 73,776 |
| 2022 | 14,834 | 11,526 | 0.28 | 60,503 |

## $75\%F_{MSY}$ Last Year Constant Projection

| year | OFL | ABC | F | SSB |
|---|---|---|---|---|
| 2020 | 25,334 | 11,526 | 0.16 | 97,150 |
| 2021 | 23,709 | 11,526 | 0.17 | 83,044 |
| 2022 | 17,945 | 11,526 | 0.23 | 73,542 |

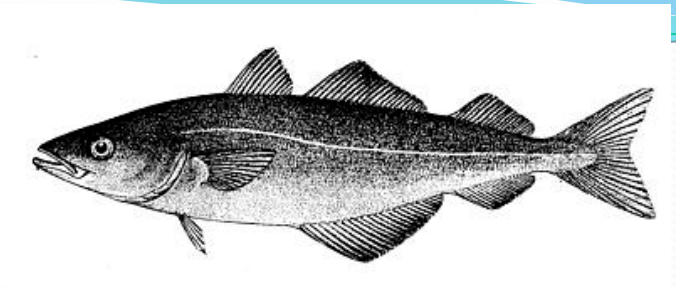
11,526 mt constant ABC was chosen by the SSC in October
(MSY = 1,597 mt, $75\%F_{MSY}$ = 1,500)

# Pollock



| | |
|---|---|
| ***MODEL*** | ASAP (Level 2) |
| ***STOCK STATUS*** | Not Overfished & Overfishing is not occurring |
| ***REBUILDING*** | Rebuilt |
| ***RETROSPECTIVE ADJUSTMENT*** | Yes |
| ***UNCERTAINTIES*** | Selectivity assumption in both surveys and the fishery, retrospective pattern, strength of 2013 year class |
| ***REVIEWER COMMENTS*** | Stock status is insensitive to the shape of the survey selectivity patterns at older ages. Convergence issues in conducting the retrospective analysis; perhaps the model is overparameterized due to separate commercial and recreational fleets. Due to the risk-prone nature of managing under the assumption of dome-shaped selectivity, the panel recommends a decision table be used to communicate the results of the base assessment model and the sensitivity model. |

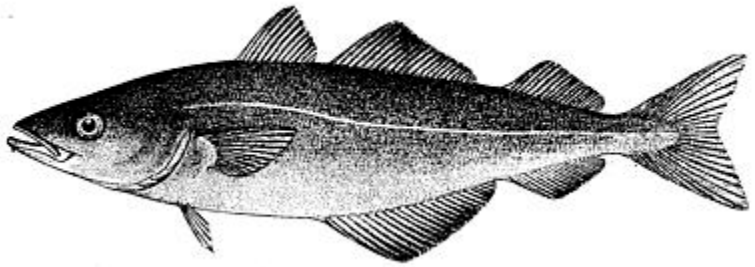
# Pollock



| | |
|---|---|
| ***CHANGES*** | New MRIP time series is incorporated in the model. |

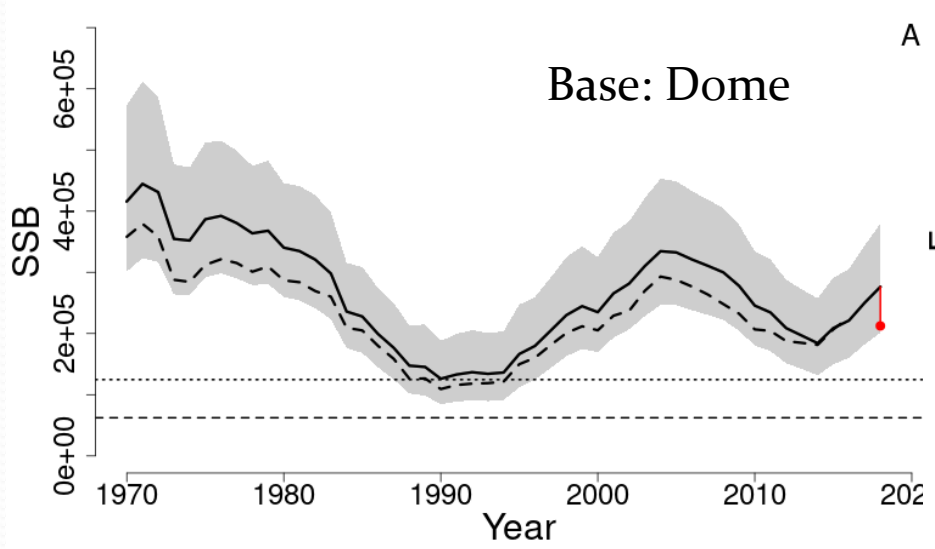
# Pollock

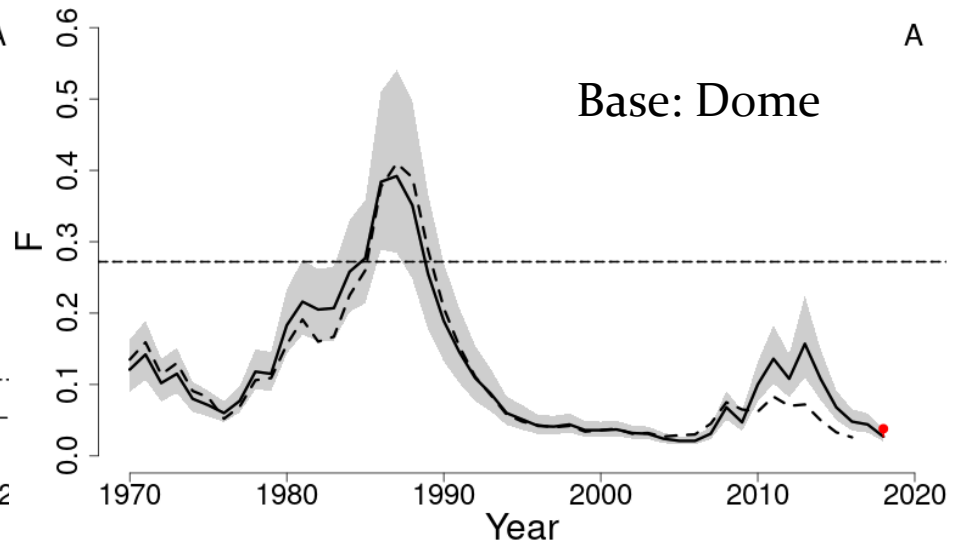
| | 2017 base | 2017 flat sel sensitivity | base | flat sel sensitivity |
|---|---|---|---|---|
| $F_{MSY}$ | 0.260 | 0.249 | 0.272 | 0.260 |
| $SSB_{MSY}$ (mt) | 105,510 | 60,738 | 124,639 (98,701 - 158,416) | 70,721 (55,964 - 89,609) |
| MSY (mt) | 19,427 | 11,692 | 19,856 (14,471 - 27,709) | 12,007 (8,876 - 16,407) |
| Median recruits (age 1) (000s) | 22,183 | 13,067 | 25,312 | 14,503 |
| *Overfishing* | No | No | No | No |
| *Overfished* | No | No | No | No |

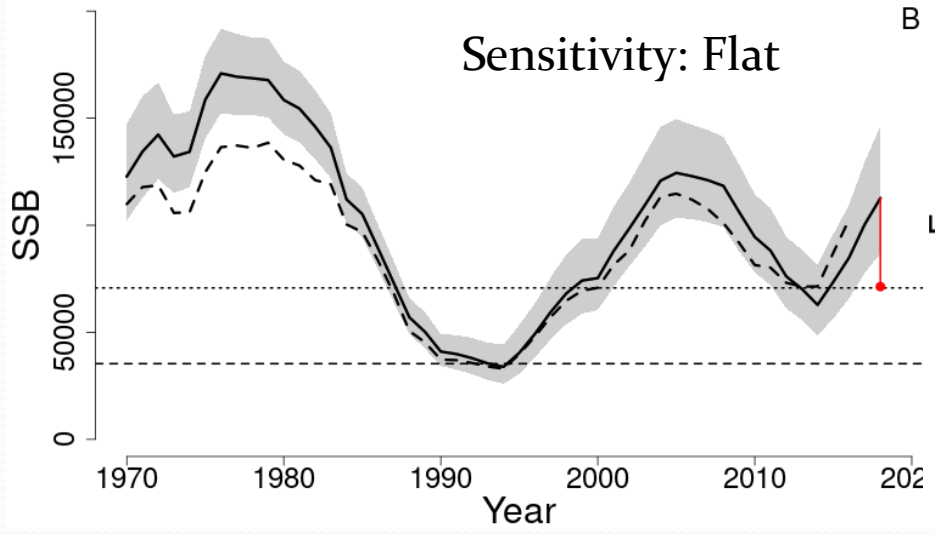


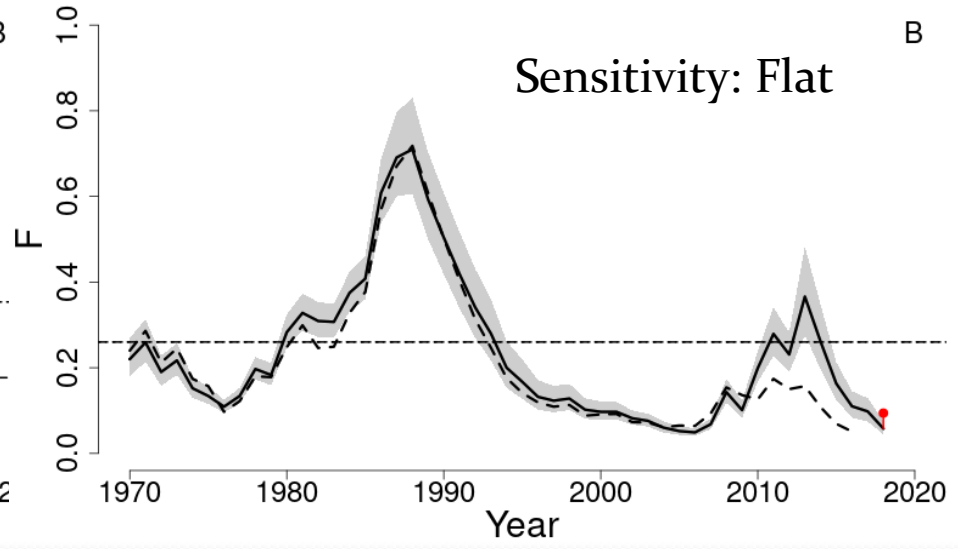
$SSB/SSB_{MSY} = 1.7$ and $F/F_{MSY} = 0.14$

# Pollock

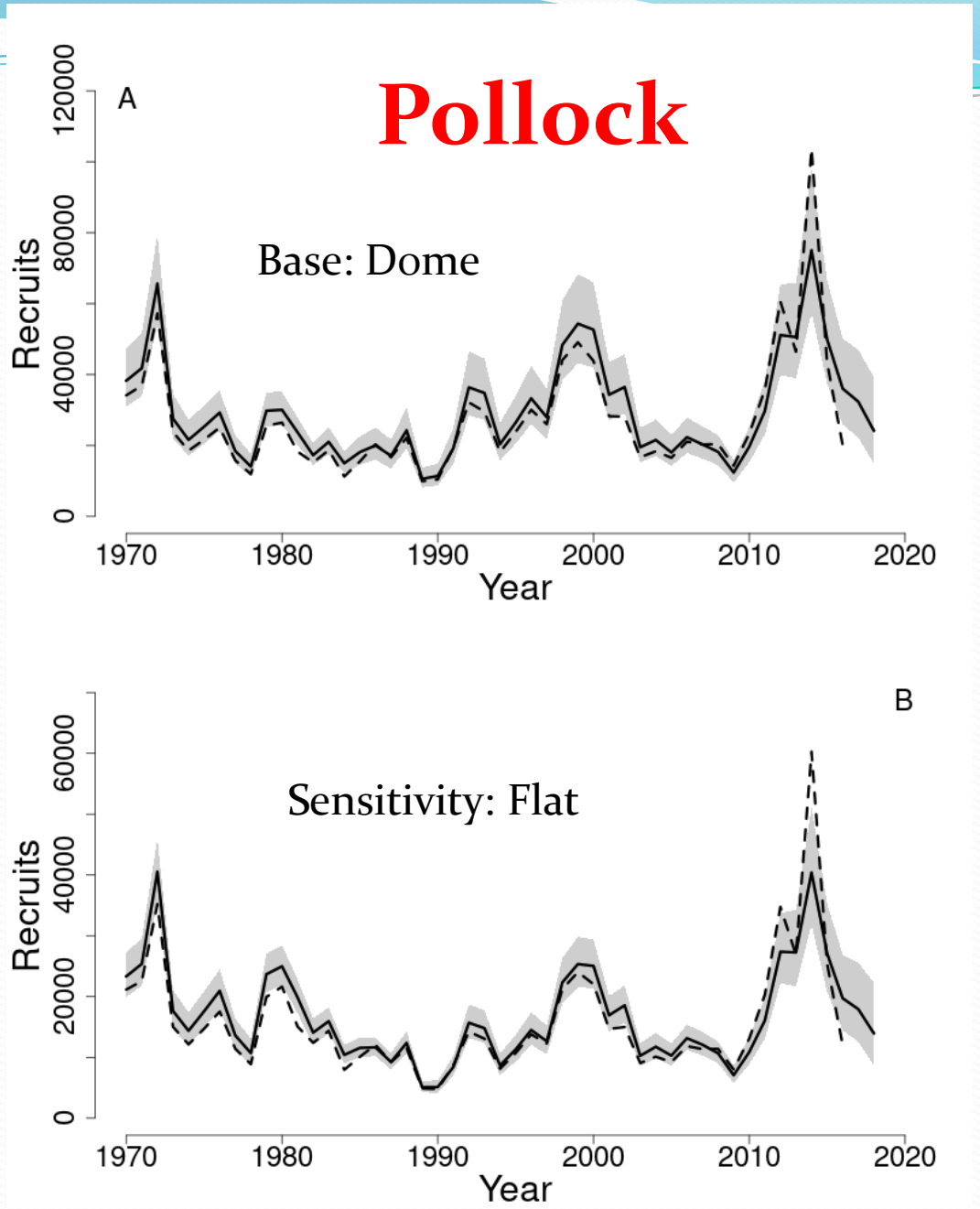

A
Base: Dome
SSB
0e+00
2e+05
4e+05
6e+05
1970
1980
1990
2000
2010
Year

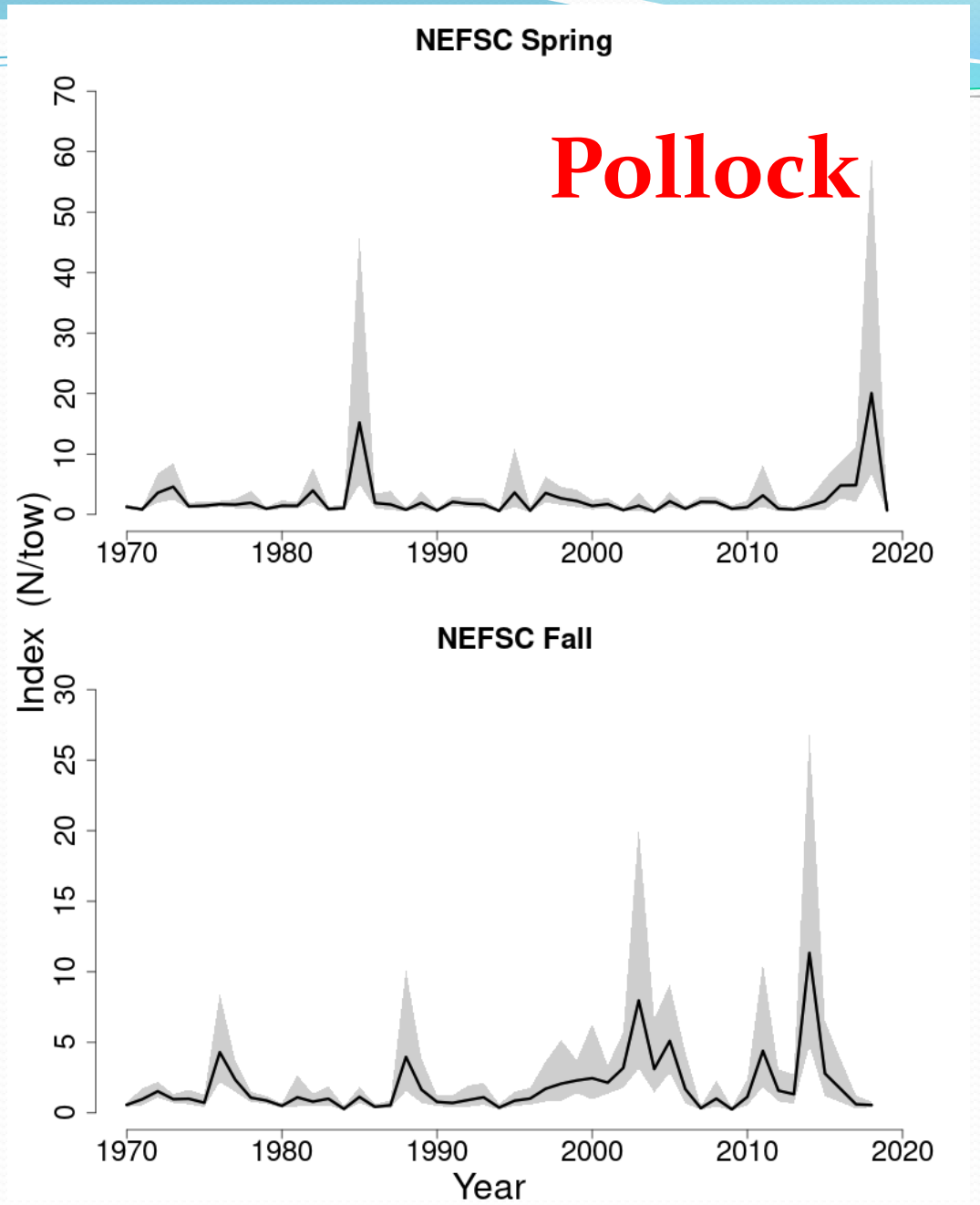

A
Base: Dome
F
0.0
0.1
0.2
0.3
0.4
0.5
0.6
1970
1980
1990
2000
2010
2020
Year


B
Sensitivity: Flat
SSB
0
50000
150000
1970
1980
1990
2000
2010
Year


B
Sensitivity: Flat
F
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

# Pollock


A
Recruits
0
40000
80000
120000
1970
1980
1990
2000
2010
2020
Year
Base: Dome
B
Recruits
0
20000
40000
60000
1970
1980
1990
2000
2010
2020
Year
Sensitivity: Flat

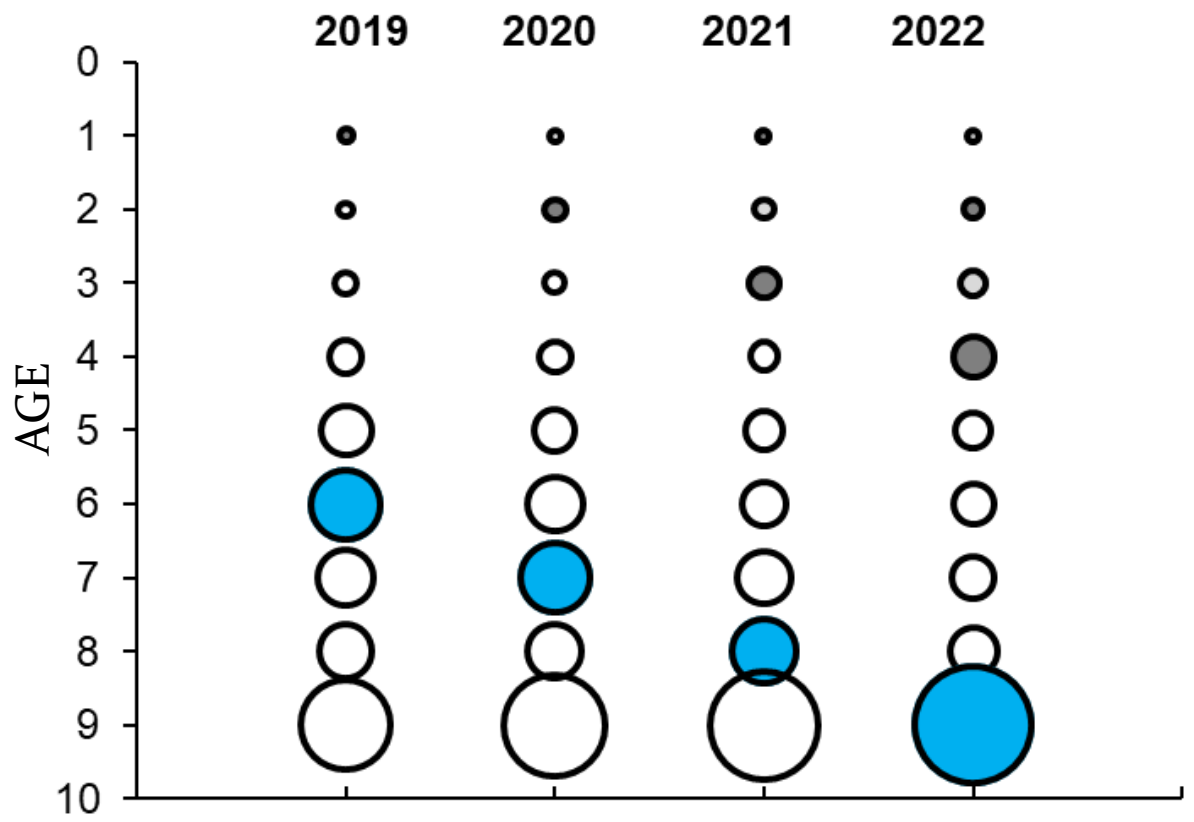

NEFSC Spring
Pollock
Index (N/tow)
0
10
20
30
40
50
60
70
1970
1980
1990
2000
2010
2020
NEFSC Fall
0
5
10
15
20
25
30
1970
1980
1990
2000
2010
2020
Year

# Pollock

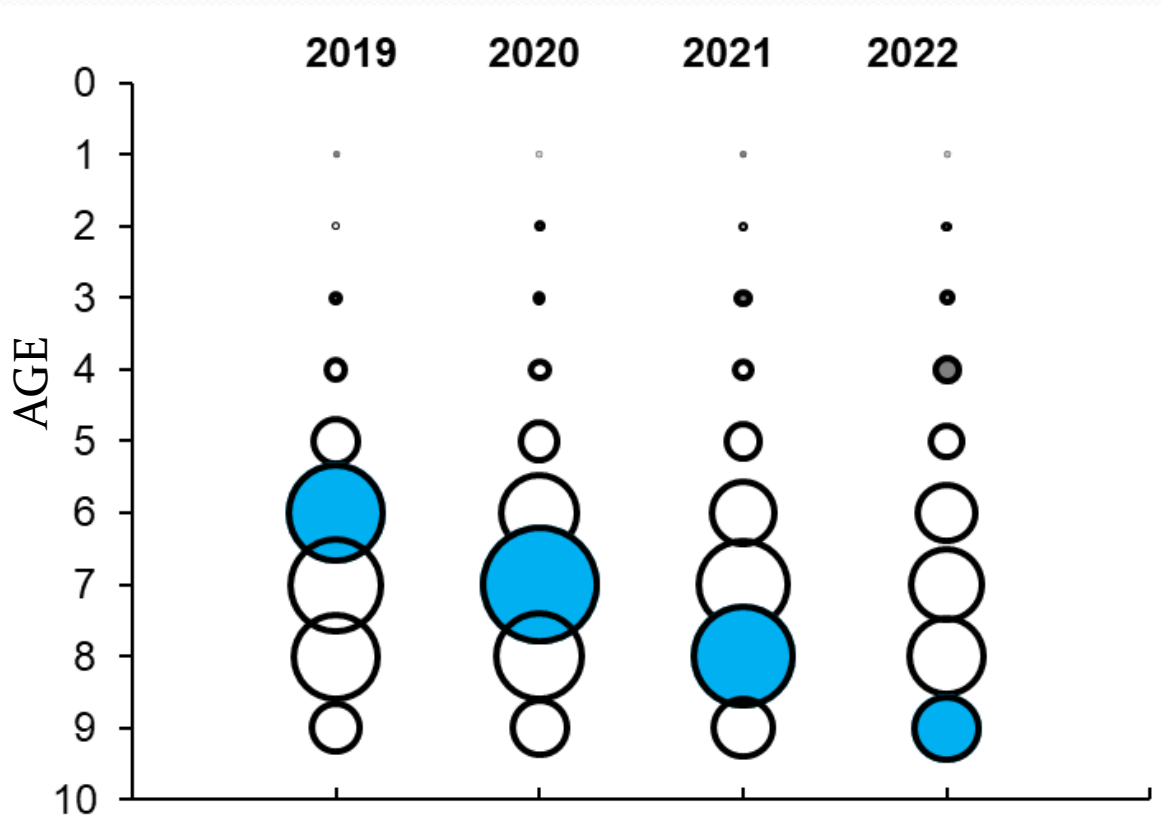
| Age | stock wt | selectivity | maturity |
|---|---|---|---|
| 1 | 0.09 | 0.05 | 0.09 |
| 2 | 0.22 | 0.07 | 0.29 |
| 3 | 0.45 | 0.11 | 0.64 |
| 4 | 0.97 | 0.16 | 0.89 |
| 5 | 1.72 | 0.33 | 0.97 |
| 6 | 2.51 | 0.72 | 0.99 |
| 7 | 3.24 | 1.00 | 1.00 |
| 8 | 3.98 | 0.92 | 1.00 |
| 9+ | 5.77 | 0.13 | 1.00 |

# Pollock

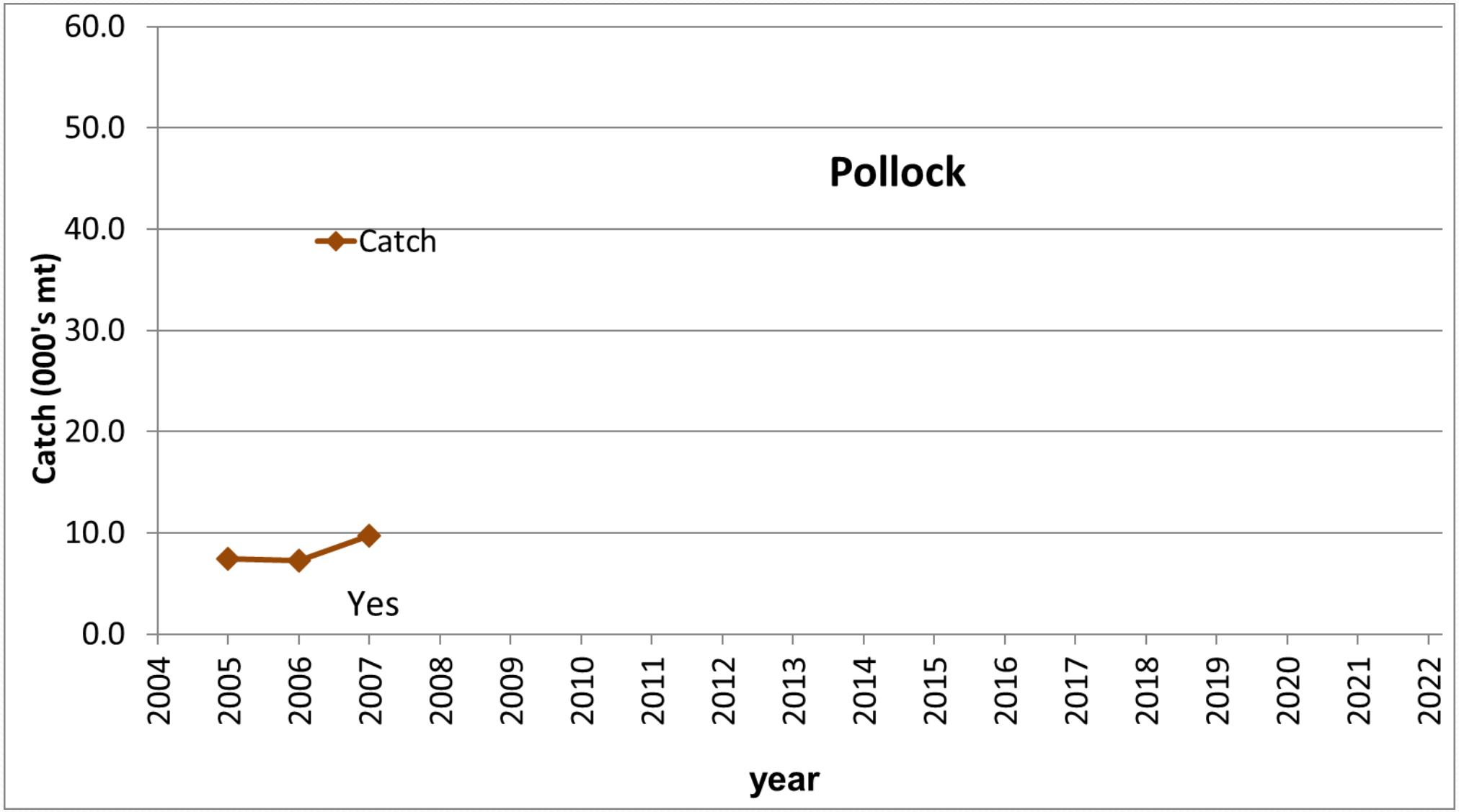
Stock Biomass



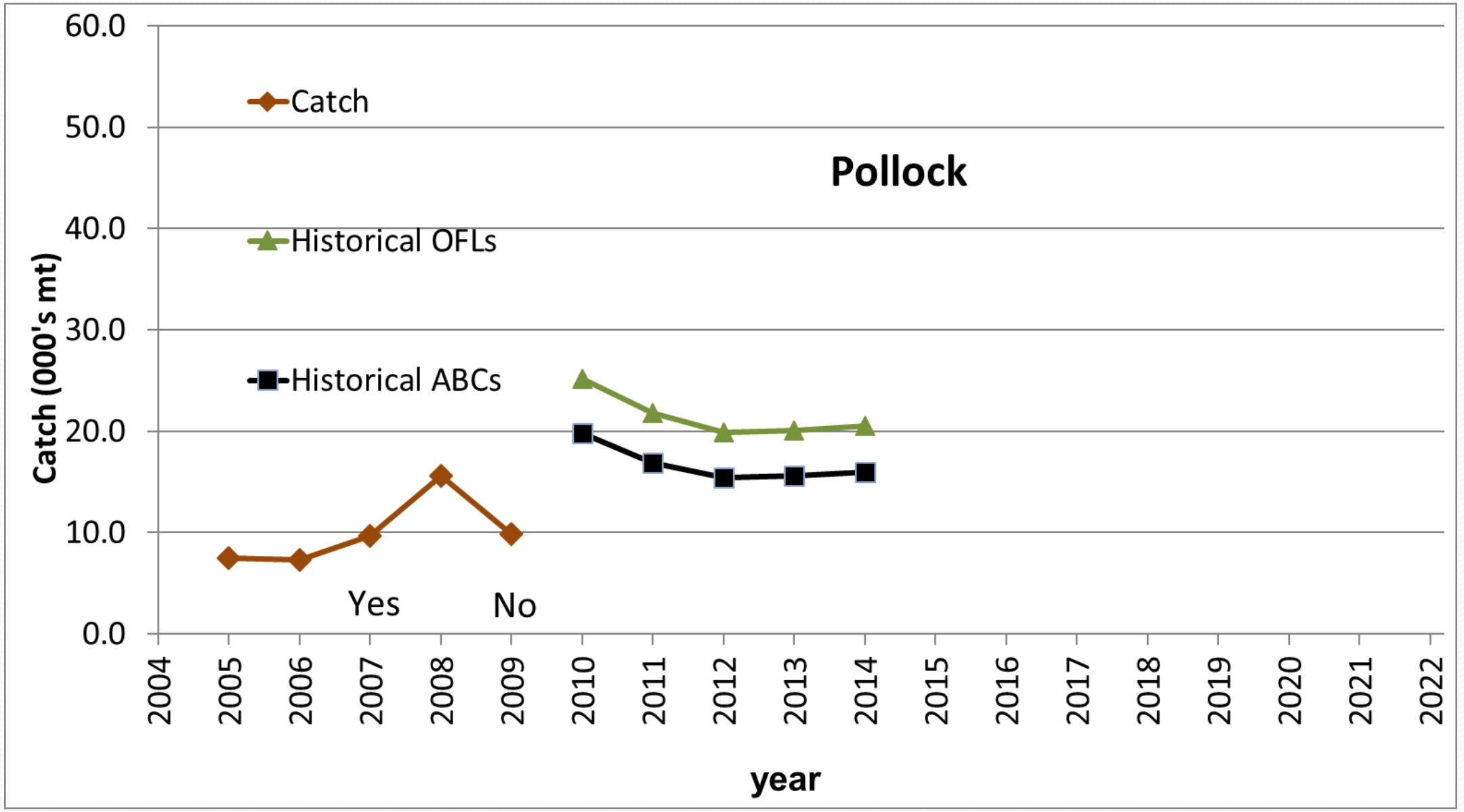

Exploitable Biomass



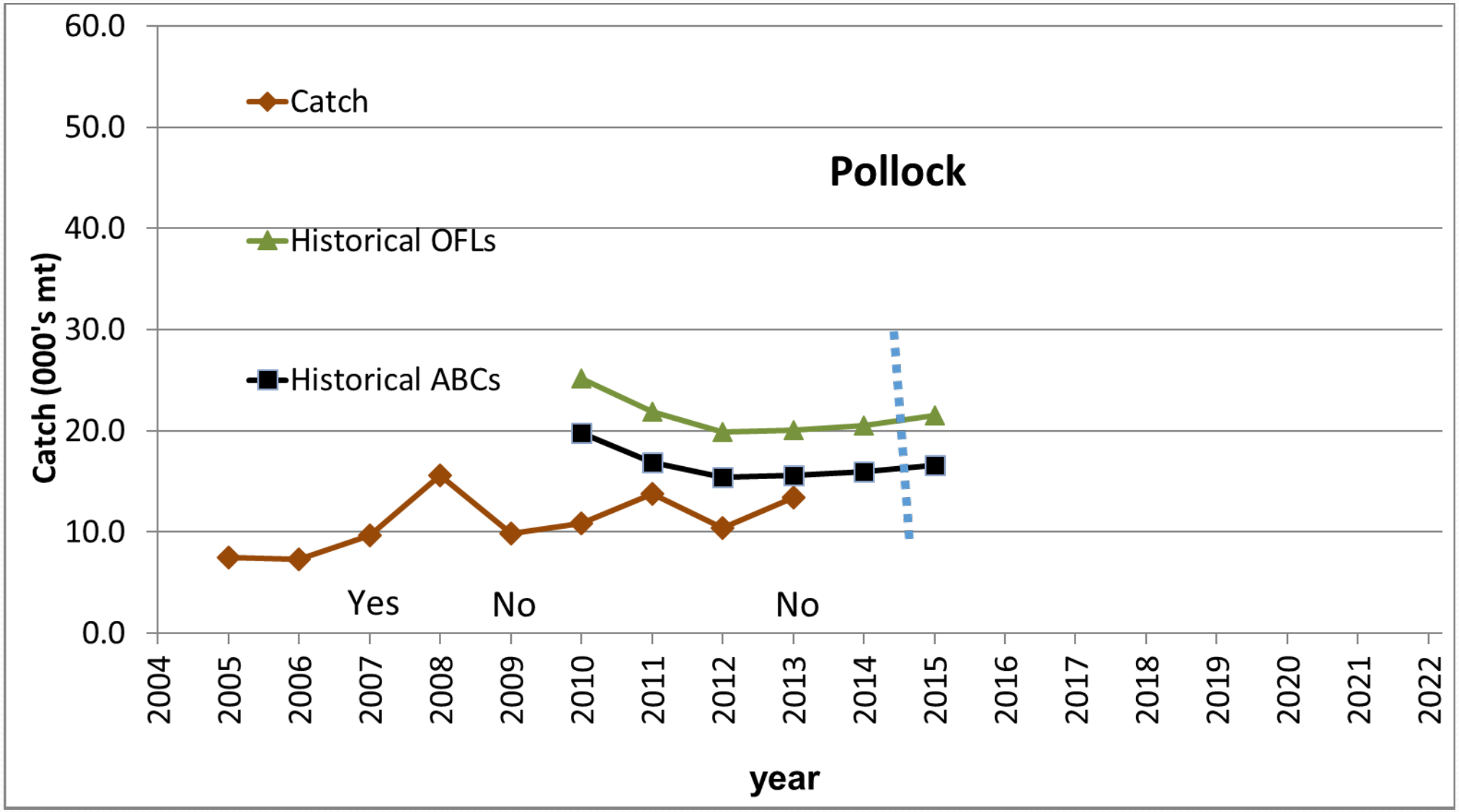
# Pollock


Pollock
Catch
Yes
Catch (000's mt)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
year

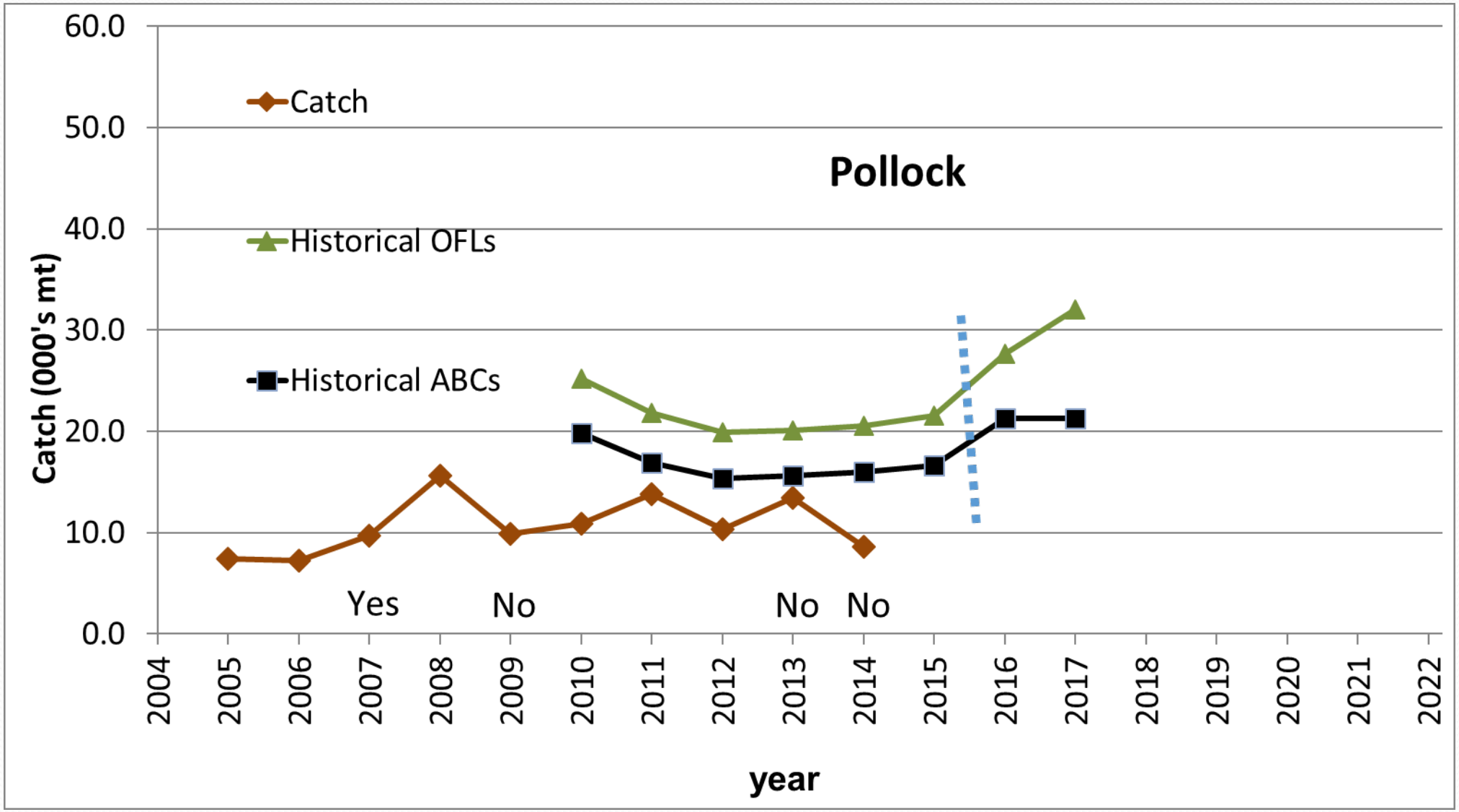
# Pollock


Pollock
Catch
Historical OFLs
Historical ABCs
Catch (000's mt)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Yes
No
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
year

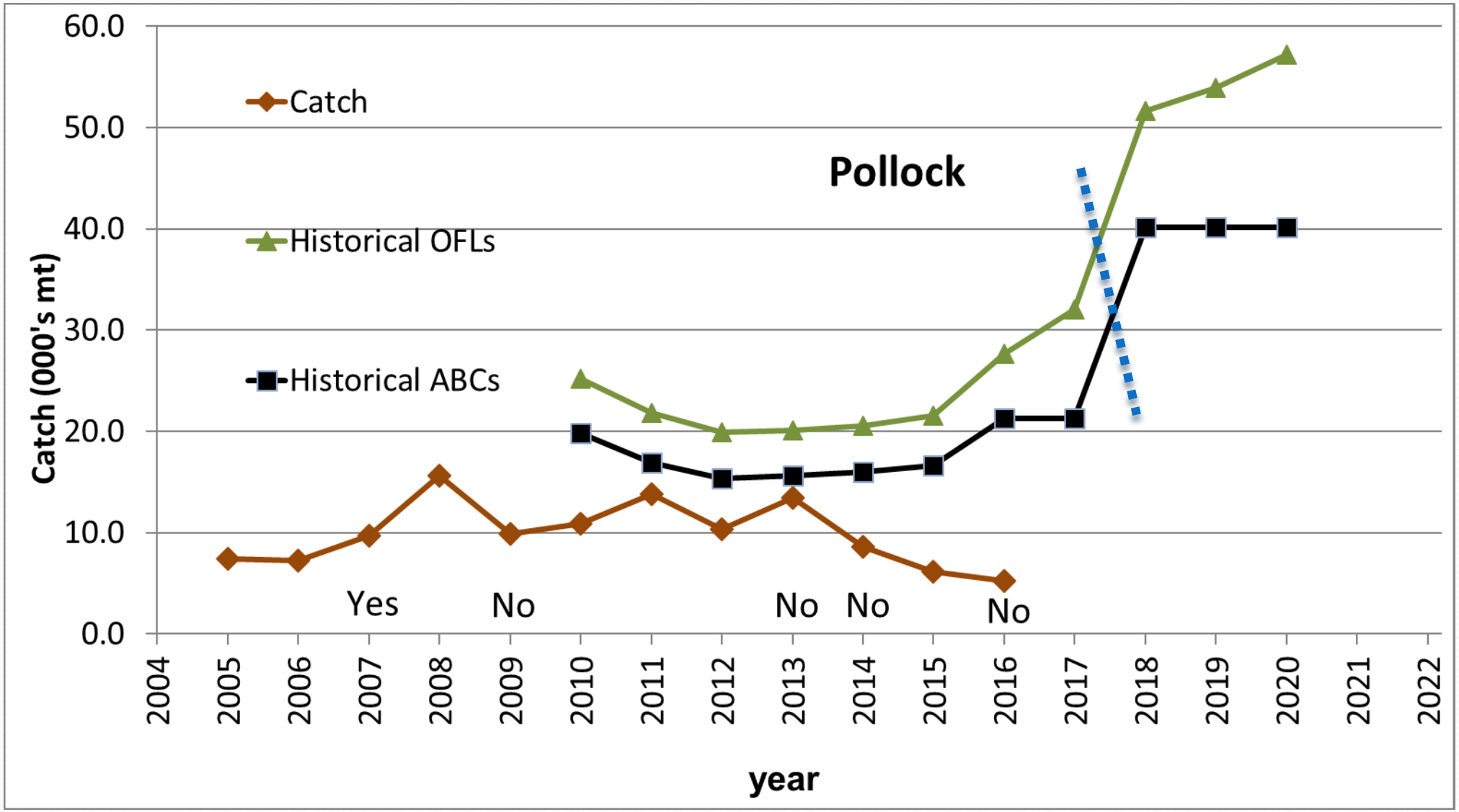
# Pollock


Pollock
Catch
Historical OFLs
Historical ABCs
Catch (000's mt)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Yes
No
No
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
year

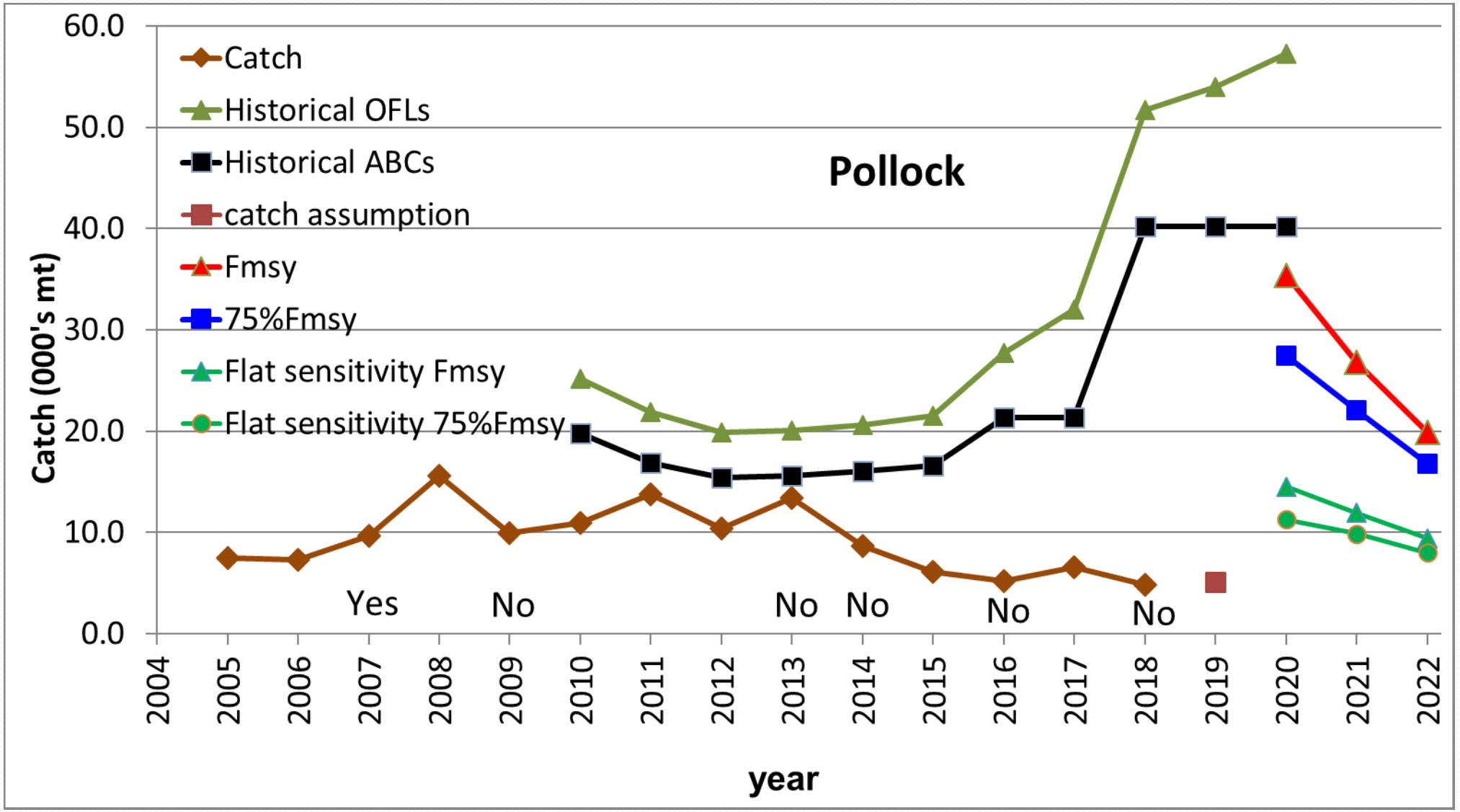
# Pollock


Pollock
Catch
Historical OFLs
Historical ABCs
Catch (000's mt)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
year
Yes
No
No
No

# Pollock


Pollock
Catch
Historical OFLs
Historical ABCs
Catch (000's mt)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
year
Yes
No
No
No
No

# Pollock


Pollock
Catch
Historical OFLs
Historical ABCs
catch assumption
Fmsy
75%Fmsy
Flat sensitivity Fmsy
Flat sensitivity 75%Fmsy
Catch (000's mt)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Yes
No
No
No
No
No
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
year

# Pollock

| Year | Catch | Historical OFLs | Historical ABCs | Catch Assumption | $F_{MSY}$ | $75\%F_{MSY}$ | Flat $F_{MSY}$ | Flat $75\%F_{MSY}$ |
|---|---|---|---|---|---|---|---|---|
| 2010 | 10,897 | 25,200 | 19,800 | | | | | |
| 2011 | 13,792 | 21,853 | 16,900 | | | | | |
| 2012 | 10,370 | 19,887 | 15,400 | | | | | |
| 2013 | 13,428 | 20,060 | 15,600 | | | | | |
| 2014 | 8,632 | 20,554 | 16,000 | | | | | |
| 2015 | 6,139 | 21,538 | 16,600 | | | | | |
| 2016 | 5,231 | 27,668 | 21,312 | | | | | |
| 2017 | 6,597 | 32,004 | 21,312 | | | | | |
| 2018 | 4,779 | 51,680 | 40,172 | | | | | |
| 2019 | | 53,940 | 40,172 | 5,140 | | | | |
| 2020 | | 57,240 | 40,172 | | 35,358 | 27,447 | 14,522 | 11,295 |
| 2021 | | | | | 26,765 | 22,062 | 11,924 | 9,867 |
| 2022 | | | | | 19,889 | 16,812 | 9,388 | 7,998 |

# Pollock

## Consequence Table

**Biological status risk over the three years**

**state of nature**

*final*

*75%Fmsy final model catch in final model*

| management catch | | F | catch | SSB |
|---|---|---|---|---|
| *final* | 2019 | 0.036 | 5,140 | 190,927 |
| | 2020 | 0.204 | 27,447 | 200,992 |
| | 2021 | 0.204 | 22,062 | 184,293 |
| | 2022 | 0.204 | 16,812 | 173,453 |

*sensitivity*

*75%Fmsy final model catch in sensitivity model*

| | F | catch | SSB |
|---|---|---|---|
| 2019 | 0.092 | 5,140 | 65,237 |
| 2020 | 0.583 | 27,447 | 69,808 |
| 2021 | 0.841 | 22,062 | 50,041 |
| 2022 | 1.133 | 16,812 | 36,160 |

*75%Fmsy sensitivity catch in final model*

| management catch | | F | catch | SSB |
|---|---|---|---|---|
| *sensitivity* | 2019 | 0.036 | 5,140 | 190,927 |
| | 2020 | 0.079 | 11,295 | 200,992 |
| | 2021 | 0.076 | 9,867 | 200,898 |
| | 2022 | 0.077 | 7,998 | 203,429 |

*75%Fmsy sensitivity catch in sensitivity model*

| | F | catch | SSB |
|---|---|---|---|
| 2019 | 0.092 | 5,140 | 65,237 |
| 2020 | 0.195 | 11,295 | 69,808 |
| 2021 | 0.195 | 9,867 | 66,606 |
| 2022 | 0.195 | 7,998 | 65,482 |

# Pollock

## $75\%F_{MSY}$ Projection

| year | OFL | ABC | F | SSB |
|---|---|---|---|---|
| 2020 | 35,358 | 27,447 | 0.30 | 201,031 |
| 2021 | 28,475 | 22,062 | 0.30 | 184,358 |
| 2022 | 21,744 | 16,812 | 0.30 | 173,494 |

## $75\%F_{MSY}$ Last Year Constant Projection

| year | OFL | ABC | F | SSB |
|---|---|---|---|---|
| 2020 | 35,358 | 16,812 | 0.18 | 201,031 |
| 2021 | 30,795 | 16,812 | 0.20 | 195,203 |
| 2022 | 24,087 | 16,812 | 0.27 | 190,204 |

16,812 mt constant ABC was chosen by the SSC in October
(MSY = 19,856, mt, $75\%F_{MSY}$ = 17,728)

## *Overview of Presentation*

- *Biological - background on constant quotas, projection performance, and individual stock assessments with projected quotas*
- *Economic - summary of QCM results*
- *Social - summary of analysis*

# Economic Impacts - Quota Change Model

Methods:

- For the sector component of the groundfish fishery only
- Uses FY 2018 effort, ex-vessel prices, quota costs
- 500 synthetic fishing years are estimated
- Predicts landings and revenue under
  - Alternative 1/No Action and
  - Alternative 2/Proposed FY 2020 sub-ACLs

# Quota Change Model (QCM)- Past Performance

- The QCM has over-predicted groundfish revenue in the last three fishing years due in part to declining prices for groundfish stocks:
  - FY16: overpredicted groundfish revenue by $4.6 million
  - FY17: overpredicted groundfish revenue by $4.2 million
  - FY18: overpredicted groundfish revenue by $9.5 million

    *FY18 used FY16 data (prices).*
- Average price for groundfish stocks declined from $1.52 in FY16 to $1.11 in FY18

# QCM- Past Performance

**QCM Predicted and Realized Revenue (millions of $)**

| | FY2016 | | FY2017* | | FY2018 | |
|---|---|---|---|---|---|---|
| | Predicted | Realized | Predicted | Realized | Predicted | Realized |
| Groundfish Revenue | 56.4 | 51.8 | 50.9 | 46.7 | 58.9 | 49.4 |
| Total Revenue | 74.3 | 78.3 | 73.5 | 70.1 | 83.9 | 72.1 |
| Operating Cost | 17.9 | 14.1 | 13.5 | 13 | 15.6 | 12.5 |
| Sector Cost | 2.0 | 1.7 | 1.7 | 1.8 | 1.7 | 2.0 |
| Quota Cost | 6.1 | 10.2 | 7.1 | 9.4 | 12 | 5.4 |
| Operating Profit | 48.4 | 52.4 | 51.2 | 46 | 54.5 | 52.2 |

**FY2017 prediction incorporates NEFS IX stranded quota*

# QCM Results

- Alternative 2 is predicted to generate $3.0 million more in groundfish revenue in FY2020 than No Action.
- FY2020 Alternative 1/No Action:
  - $46 million in groundfish revenue
  - $65.2 million in total revenue
- FY2020 Alternative 2:
  - Under constant control rule
    - $48.9 million in groundfish revenue
    - $69.9 million in total revenue
  - Under 75% FMSY
    - $49.0 million in groundfish revenue
    - $70.0 million in total revenue

# QCM Results

**Comparison Stock-level Catch, Utilization, and Revenue (2018 $, millions)**

| Option | Groundfish Gross Revenues | Total Gross Revenues | Operating Cost | Sector Cost | Quota Cost | Operating Profit | Days Absent |
|---|---|---|---|---|---|---|---|
| *FY18 Realized* | *49.4* | *72.1* | *12.5* | *2.0* | *5.4* | *52.2* | *10,952* |
| FY20 Prediction (Alt1/No Action) | 46.0 | 65.2 | 11.7 | 1.8 | 5.2 | 46.5 | 10,209 |
| FY20 Prediction (Alt 2, constant) | 48.9 | 69.9 | 12.5 | 1.9 | 5.4 | 50.2 | 10,907 |
| FY20 Prediction (Alt 2, 75% FMSY) | 49.0 | 70.0 | 12.5 | 1.9 | 5.4 | 50.2 | 10,942 |

# QCM Results: Stock-level changes under Alternative 2

- In FY 2020, GOM cod, GB winter flounder, SNE/MA yellowtail flounder predicted to be limiting (>99% utilization)
- White hake and GB cod west also predicted to be nearly fully utilized (>90% utilization)

# QCM Results: Stock-level changes under Alternative 2

| | Sub-ACL (mt), | Predicted Catch (mt) | Predicted Utilization |
|---|---|---|---|
| GB Haddock West | 52,335 | 4,430 | 4.3% |
| GOM Haddock | 6,939 | 2,735 | 22.9% |
| Redfish | 11,173 | 4,898 | 43.8% |
| Plaice | 2,574 | 1,104 | 38.2% |
| Pollock | 13,803 | 2,943 | 12.4% |
| White Hake | 2,004 | 1,848 | 92.2% |
| GB Winter Flounder | 501 | 498 | 99.4% |
| GB Cod West | 851 | 826 | 97.0% |
| Witch Flounder | 1,275 | 873 | 68.5% |
| SNE Winter Flounder | 462 | 312 | 67.6% |
| GOM Cod | 267 | 267 | 99.9% |
| GB Haddock East | 16,084 | 700 | 4.4% |
| GB Cod East | 185 | 133 | 72.2% |
| GOM Winter Flounder | 272 | 95 | 34.9% |
| CC/GOM Yellowtail Flounder | 651 | 177 | 27.3% |
| GB Yellowtail Flounder | 93 | 28 | 29.8% |
| SNE/MA Yellowtail Flounder | 12 | 12 | 99.8% |

# QCM Results: Stock-level changes under Alternative 2

**Constant**

| | Sub-ACL (mt) | Predicted Catch (mt) | Predicted Utilization |
|---|---|---|---|
| GB Haddock West | 52,335 | 4,445 | 8.5% |
| GOM Haddock | 6,939 | 2,735 | 39.4% |
| Plaice | 2,574 | 1,104 | 42.9% |
| Pollock | 13,803 | 2,935 | 21.3% |

**75% FMSY**

| | Sub-ACL (mt) | Predicted Catch (mt) | Predicted Utilization |
|---|---|---|---|
| GB Haddock West | 103,849 | 4,430 | 4.3% |
| GOM Haddock | 11,918 | 2,735 | 22.9% |
| Plaice | 2,889 | 1,104 | 38.2% |
| Pollock | 23,830 | 2,943 | 12.4% |

## QCM Results: Port-level changes under Alternative 2

- Most major ports predicted to see decreases in revenue in FY2020 compared to FY19 and FY18 predictions
  - New Bedford precited to have identical revenue compared to FY19, $8.1 million
  - Gloucester: $2.1 million less than predicted FY19
  - Boston: $1.9 million less than predicted FY19
  - Portland: $1.8 million less than predicted FY19

# QCM Results: Port-level changes under Alternative 2

| | FY20 Prediction | FY19 Prediction | FY18 Prediction |
|---|---|---|---|
| Gloucester | 12.5 | 14.6 | 14.0 |
| Boston | 11.6 | 13.5 | 13.2 |
| Portland | 7.4 | 9.2 | 8.3 |
| New Bedford | 8.1 | 8.1 | 13.2 |

**Results for these top four groundfish ports are identical under both constant and 75% quota approaches.**

# *Overview of Presentation*

- *Biological - background on constant quotas, projection performance, and individual stock assessments with projected quotas*
- *Economic - summary of QCM results*
- *Social - summary of analysis*

**Table 2- Crew Satisfaction with predictability of earnings, 2012 and 2018 Crew Surveys.**

| | Groundfish Crew | Other Crew | Total Crew |
|---|---|---|---|
| | N (%) | N (%) | N (%) |
| Total | 105 (100%) | 732 (100%) | 837 (100%) |
| Very satisfied | 0 (0%) | 32 (4%) | 32 (4%) |
| Satisfied | 23 (22%) | 312 (43%) | 335 (40%) |
| Neutral | 20 (19%) | 160 (22%) | 180 (22%) |
| Dissatisfied | 39 (37%) | 160 (22%) | 199 (24%) |
| Very dissatisfied | 21 (20%) | 66 (9%) | 87 (10%) |
| Don't know/No answer | 2 (2%) | 2 (<1%) | 4 (<1%) |

***t* = 5.97, p<.001**

*Survey question: How satisfied or dissatisfied are you with the following items relating to the job of fishing? [The predictability of your earnings]*

**Table 3- Trust in management among crew, 2012 Crew Survey Version 1 only.**

| | Groundfish Crew | Other Crew | Total Crew |
|---|---|---|---|
| | N (%) | N (%) | N (%) |
| Total | 13 (100%) | 59 (100%) | 72 (100%) |
| ***"Do not trust managing authorities"*** | | | |
| Strongly agree | 7 (54%) | 17 (29%) | 24 (33%) |
| Agree | 6 (46%) | 21 (36%) | 27 (38%) |
| Neutral | 0 (0%) | 11 (19%) | 11 (15%) |
| Disagree | 0 (0%) | 7 (12%) | 7 (10%) |
| Strongly disagree | 0 (0%) | 2 (3%) | 2 (3%) |
| Don't know/No answer | 0 (0%) | 1 (2%) | 1 (1%) |

***t* = 2.28, p<.01**

*Survey question: Please indicate the extent to which you agree or disagree with the following statements regarding the most recent federal government-led fisheries management process you participated in. [I do not trust the managing authorities to make the right decision when it comes to regulating fisheries.]*

# *Comparing constant quota and 75%FMSY quota approaches*

- *Biological*
  - Based on the 2019 assessments, GB haddock, GOM haddock, American plaice, and pollock are rebuilt, not overfished, and overfishing is not occurring.
  - Risk of overfishing appears to be low based on the 2019 stock assessment and projections.
  - Projections may be performing better for 3 of the 4 stocks based on the Wiedenmann and Jensen analysis.
  - Some caveats discussed with respect to uncertainty by stock.
- *Economic*
  - Economic impacts analysis using the QCM for sectors suggest no difference in predicted utilization between the two sets of quotas, driven largely by other limiting stocks in the multispecies fishery.
  - Some caveats discussed with respect to American plaice.
- *Social*
  - There may be some distributional impacts if quotas increase or decrease, depending on the extent that any given port or fishing community depends on the stocks in question and if the assumptions of the QCM are not fully met.
  - Trust among fishery participants is already low, so this would be a possible opportunity to increase trust among fishery stakeholders by ensuring that the appropriate steps are followed as outlined by the Council's own current ABC control rule for groundfish. Alternatively, in the past, industry has requested stability in quotas – which a constant quota approach could provide.

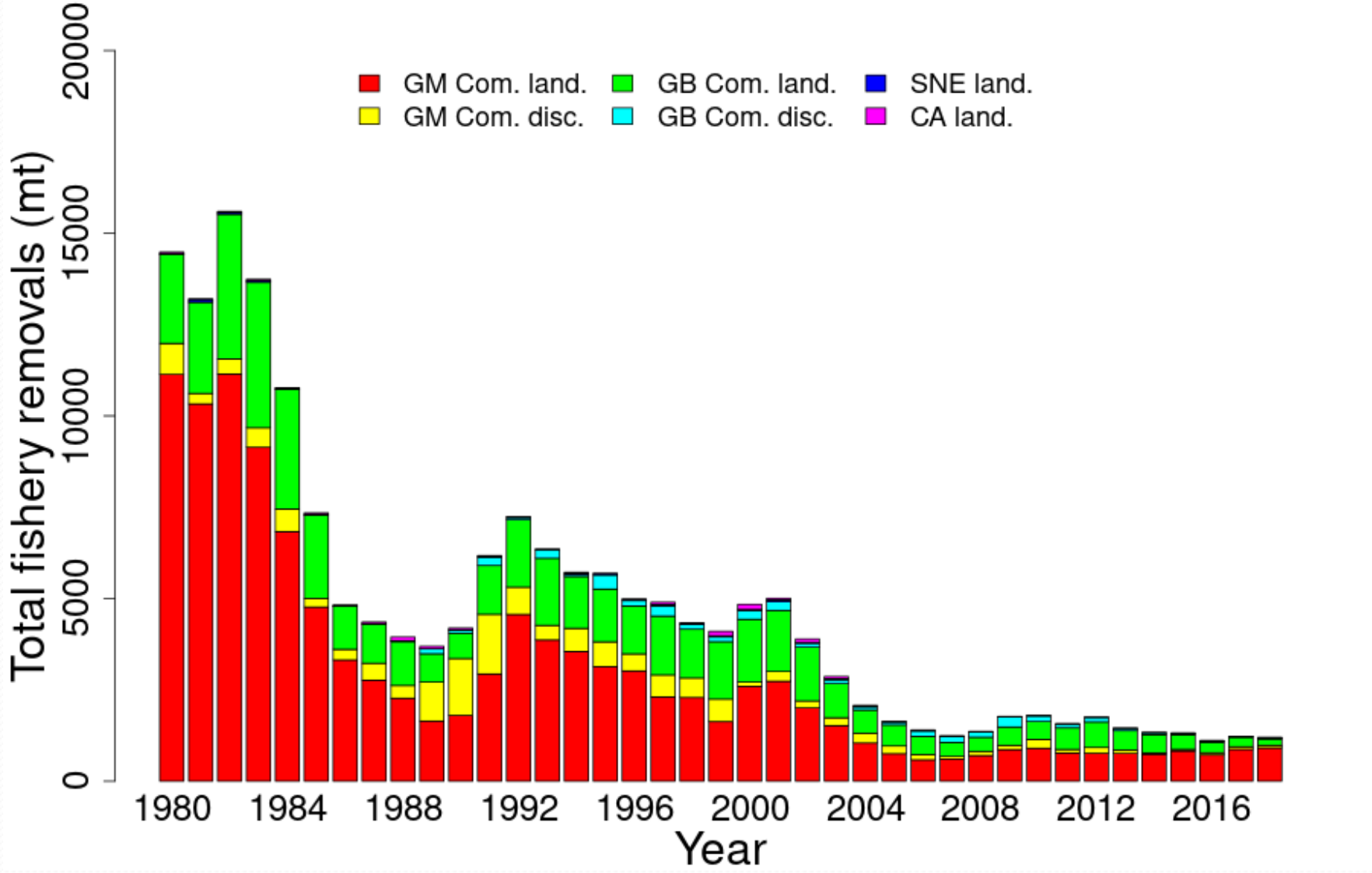
# Extra Slides

# Groundfish Control Rule

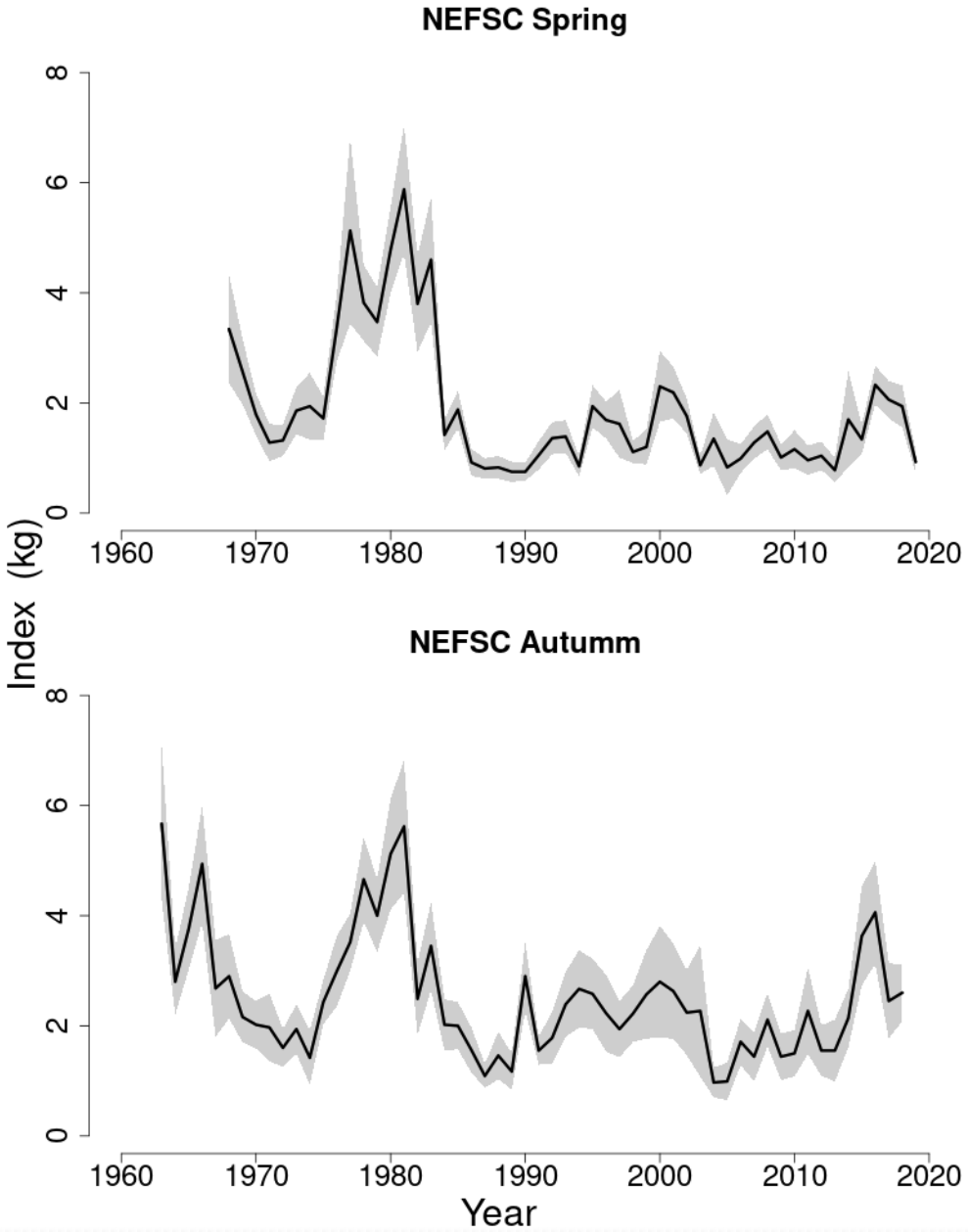
A. *ABC should be determined as the catch associated with 75% of $F_{MSY}$.*
B. *If fishing at 75% of $F_{MSY}$ does not achieve the mandated rebuilding requirements for overfished stocks, ABC should be determined as the catch associated with the fishing mortality that meets rebuilding requirements ($F_{rebuild}$).*
C. *For stocks that cannot rebuild to $B_{MSY}$ in the specified rebuilding period, even with no fishing, the ABC should be based on incidental bycatch, including a reduction in bycatch rate (i.e., the proportion of the stock caught as bycatch).*
D. *Interim ABCs should be determined for stocks with unknown status according to case- by case recommendations from the SSC*

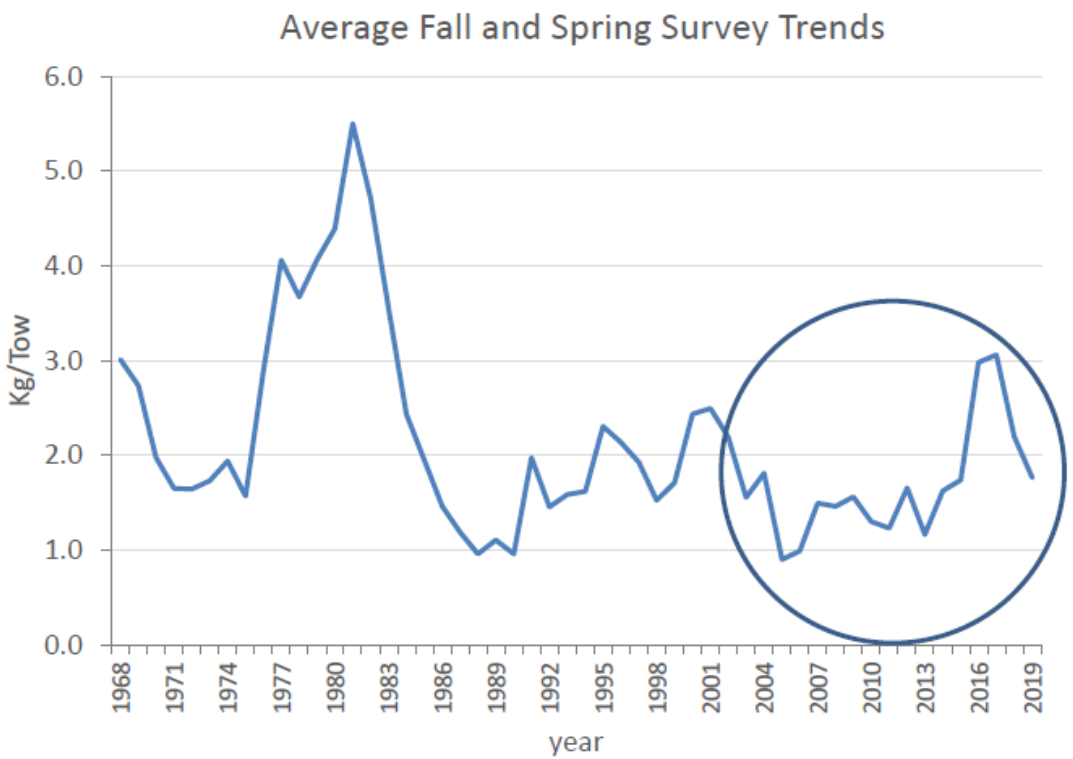
| | Plaice | GB Haddock | GOM Haddock | Pollock |
|---|---|---|---|---|
| | | | | |
| $SSB/SSB_{MSY}$ | 1.16 | 3.65 | 10.35 | 1.70 |
| $F/F_{MSY}$ | 0.09 | 0.18 | 0.22 | 0.14 |
| | | | | |
| Rho adj | @age | SSB | SSB | @age |
| | | | | |
| 1 | 0.55 | 0.59 | 1.31 | 1.08 |
| 2 | 0.66 | 0.59 | 1.31 | 0.81 |
| 3 | 0.67 | 0.59 | 1.31 | 0.71 |
| 4 | 0.78 | 0.59 | 1.31 | 0.70 |
| 5 | 0.86 | 0.59 | 1.31 | 0.72 |
| 6 | 0.84 | 0.59 | 1.31 | 0.73 |
| 7 | 0.82 | 0.59 | 1.31 | 0.74 |
| 8 | 0.76 | 0.59 | 1.31 | 0.72 |
| 9 | 0.65 | 0.59 | 1.31 | 0.80 |
| 10 | 0.81 | 0.59 | 1.31 | |
| 11 | 0.81 | 0.59 | 1.31 | |
| | | | | |
| t+1 | surveys | surveys | geo mean | survey |

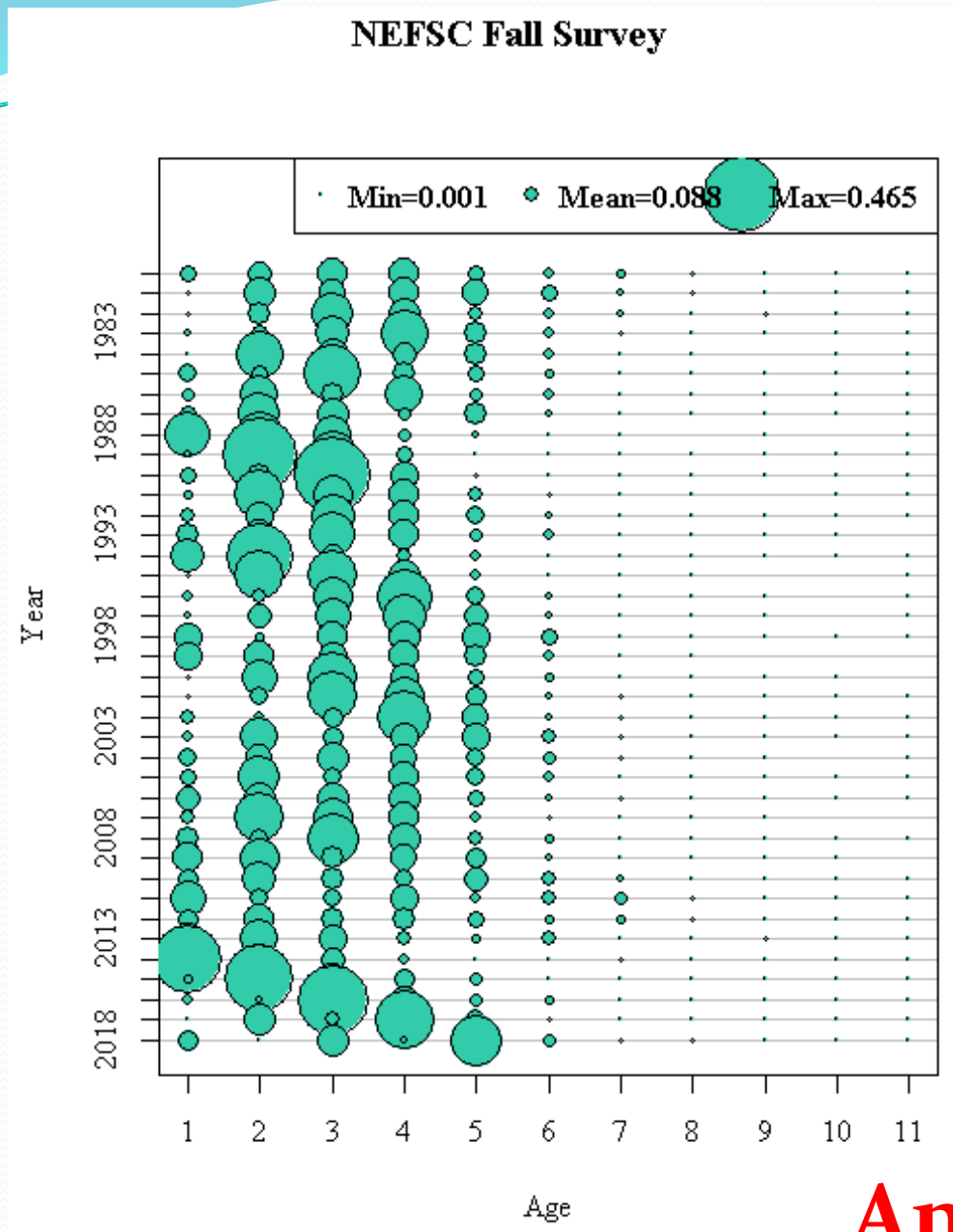
# American Plaice

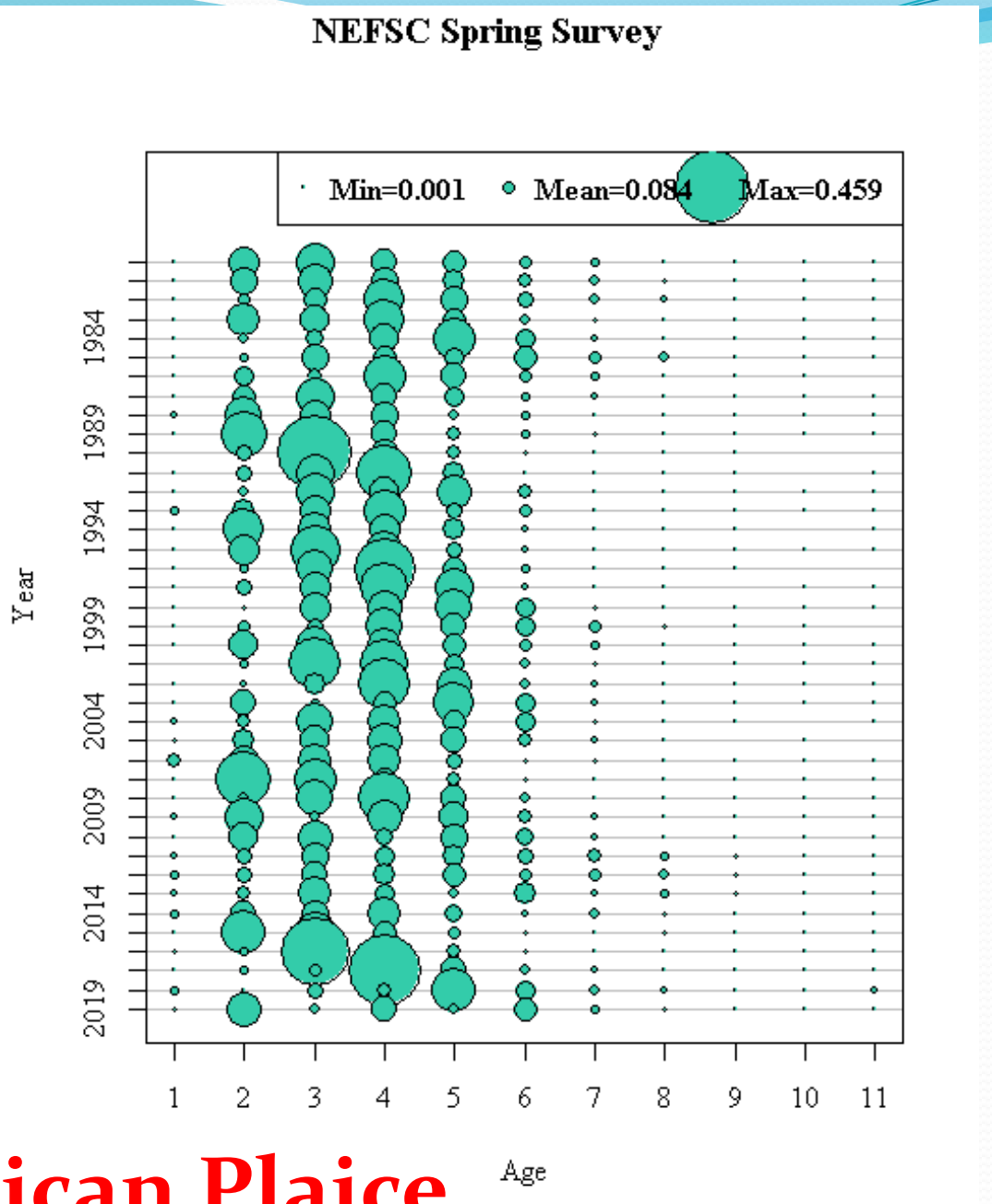


# American Plaice



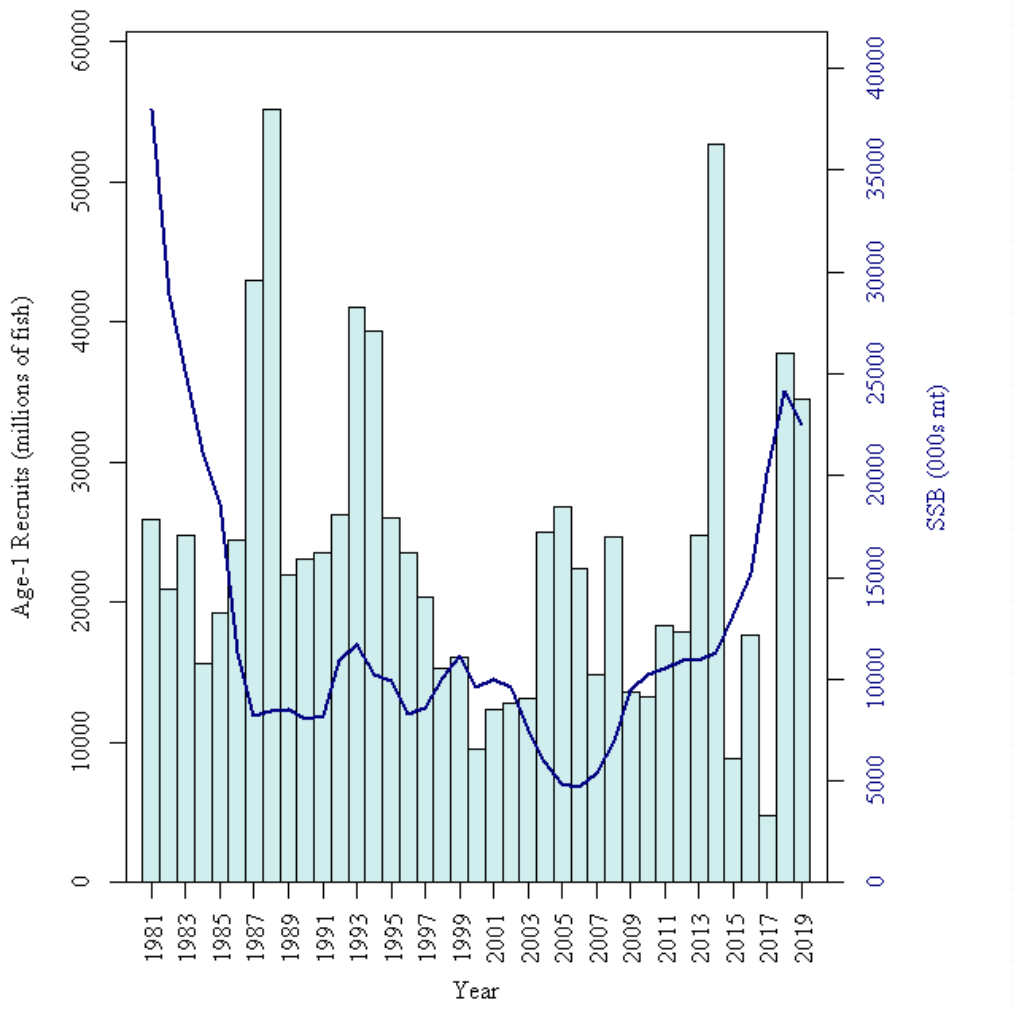



# American Plaice

# American Plaice


Age-1 Recruitment vs. SSB



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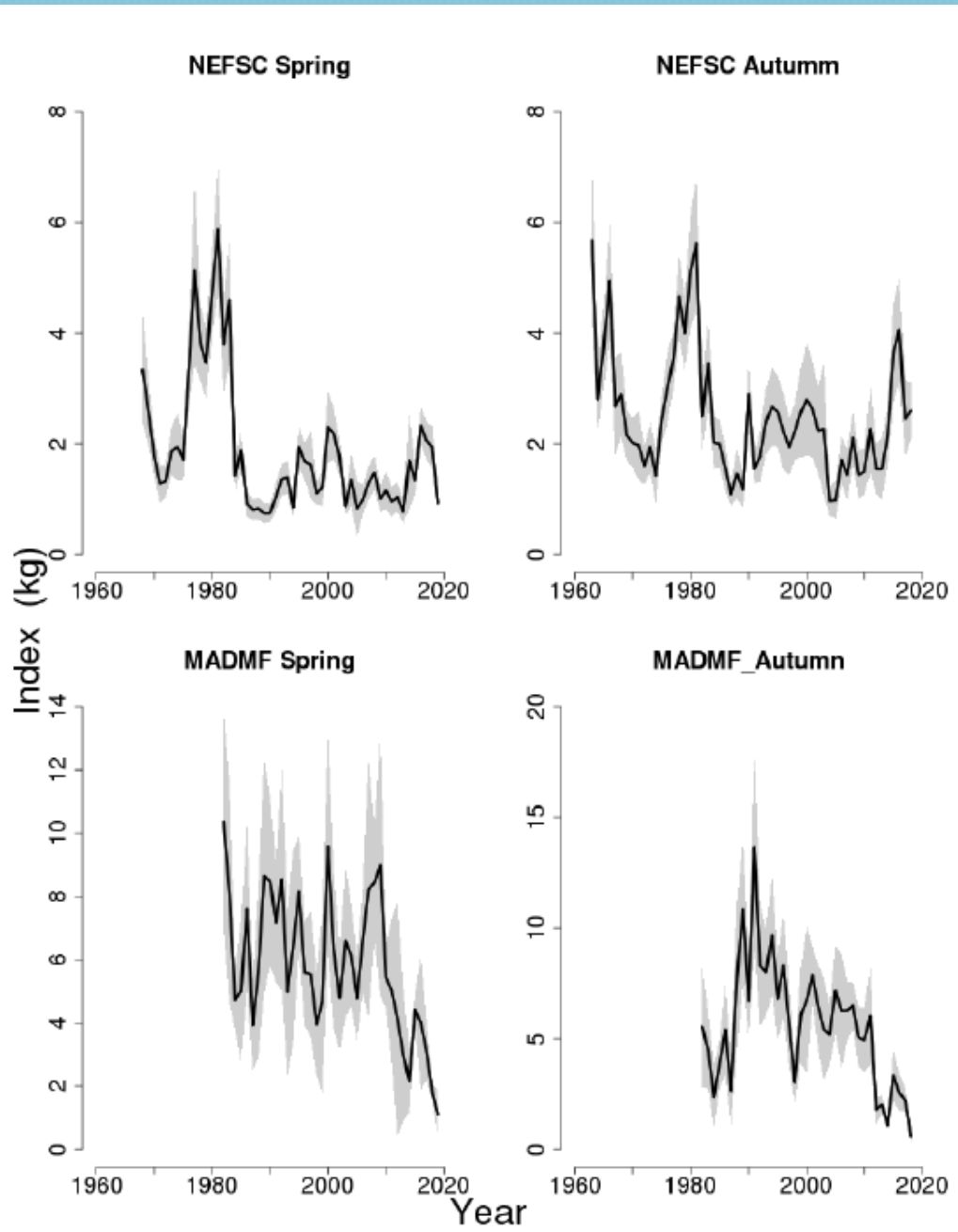
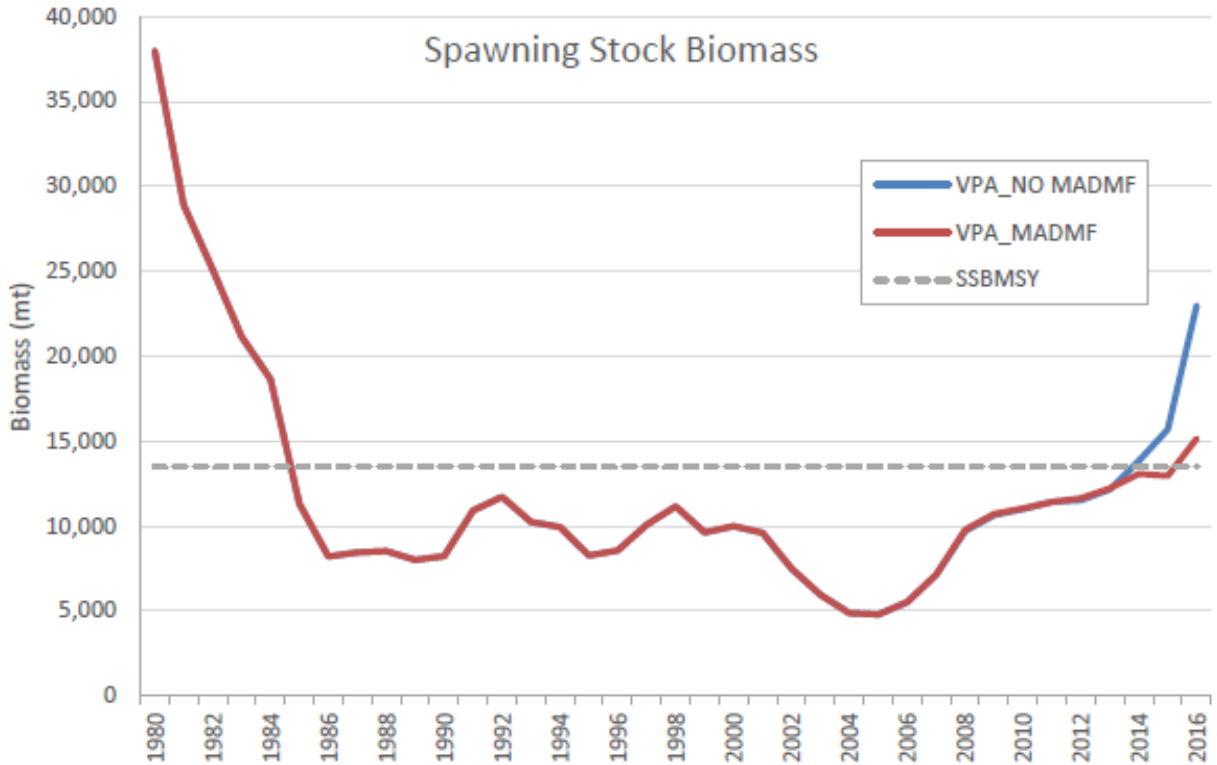
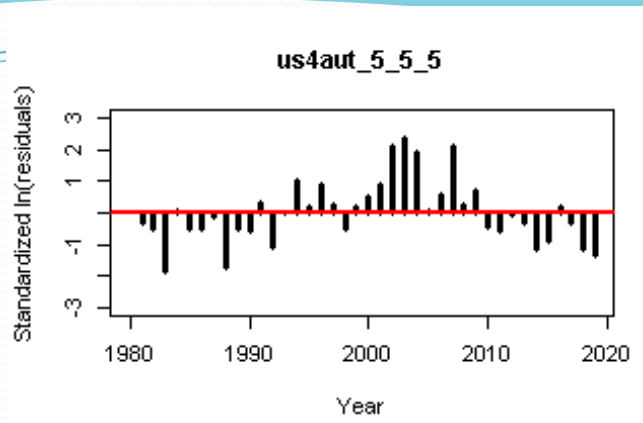
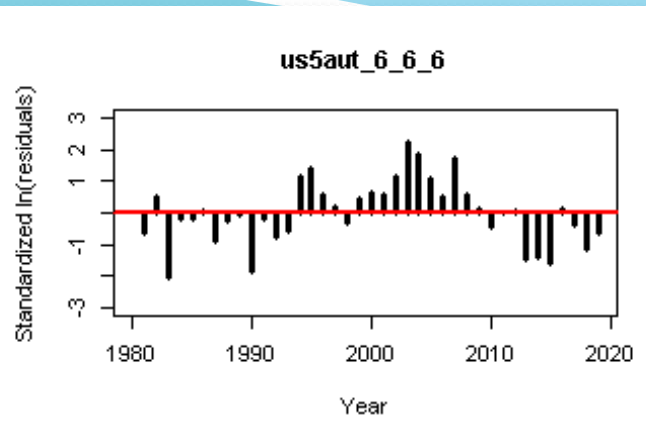
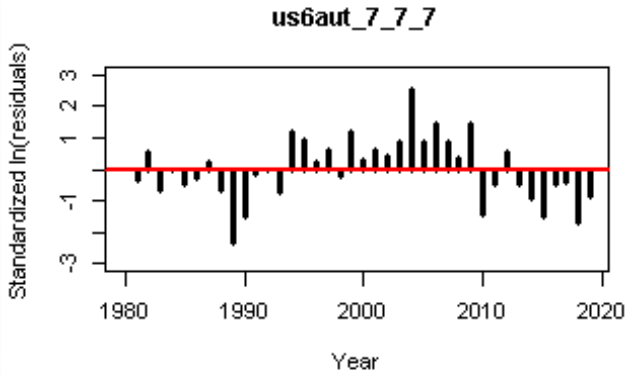
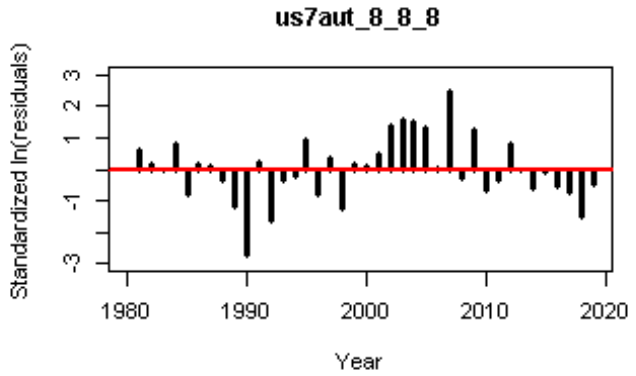


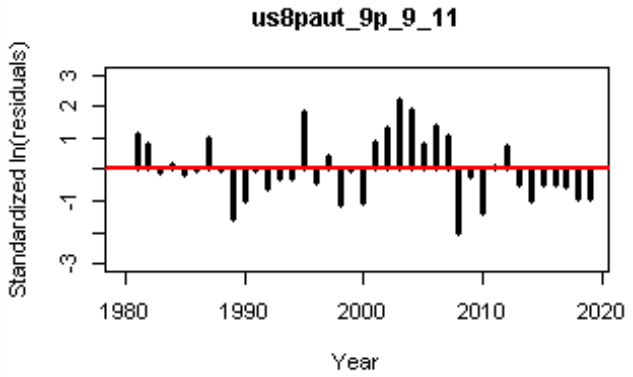





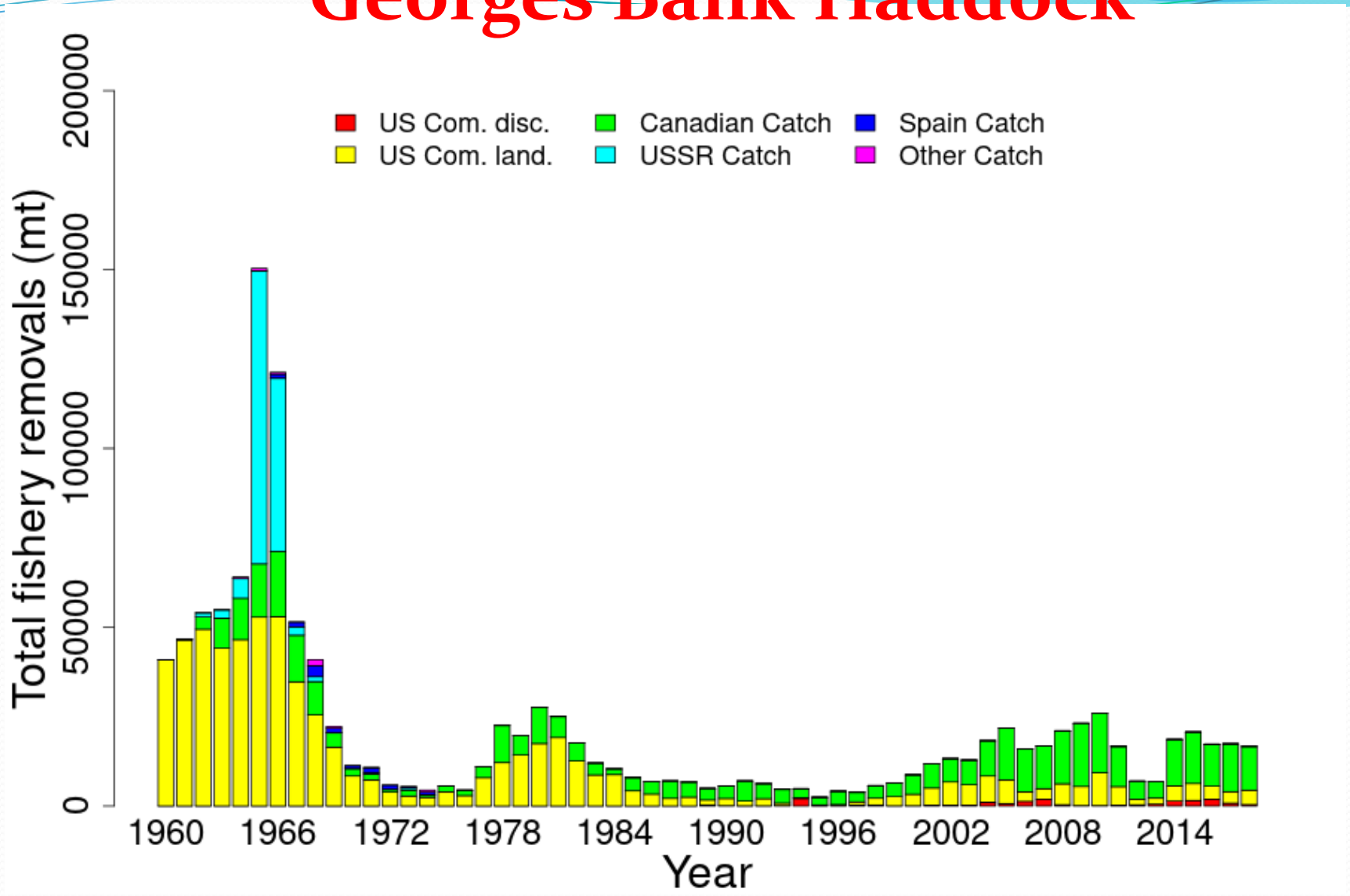



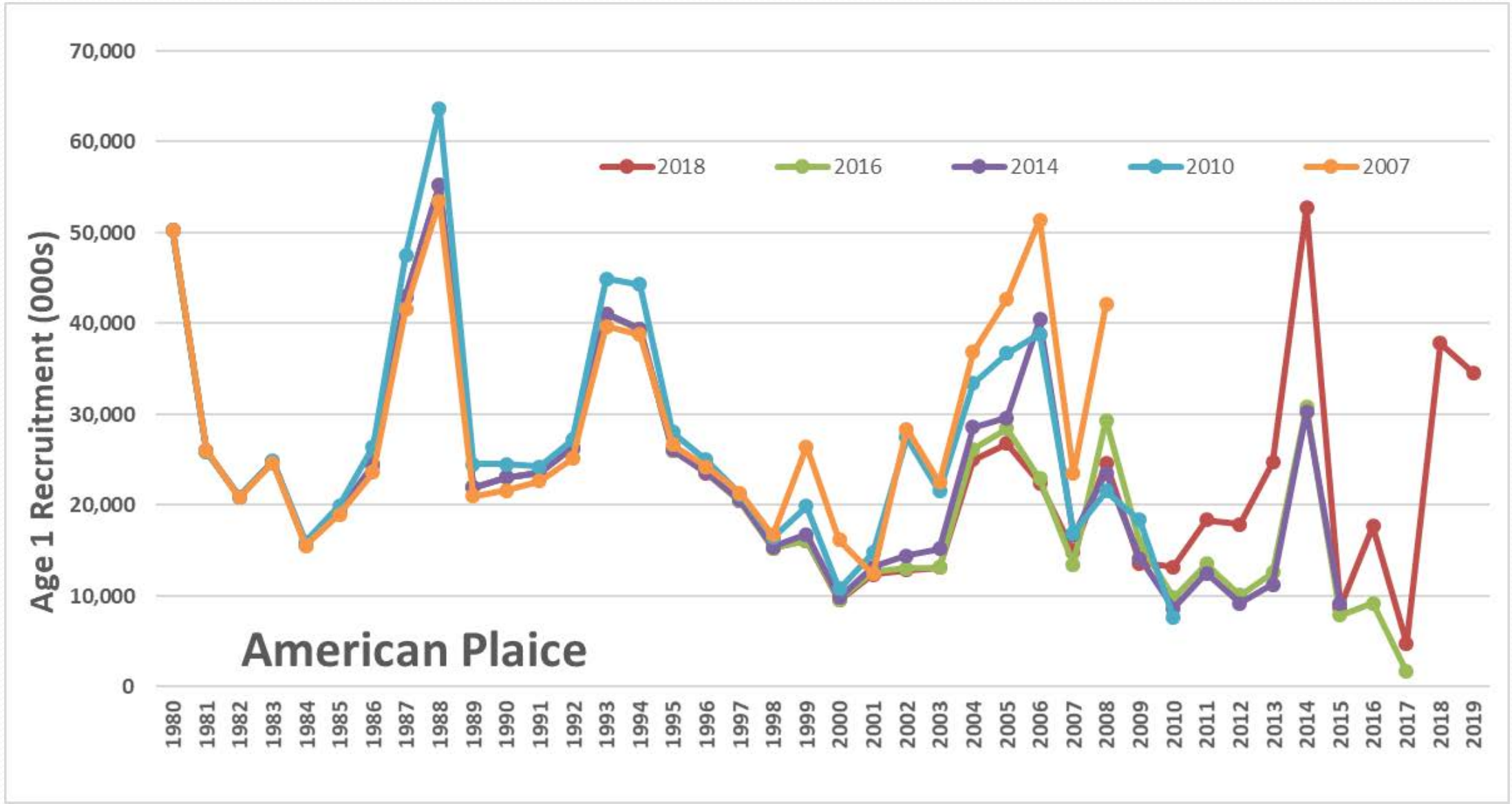

# American Plaice

# Georges Bank Haddock

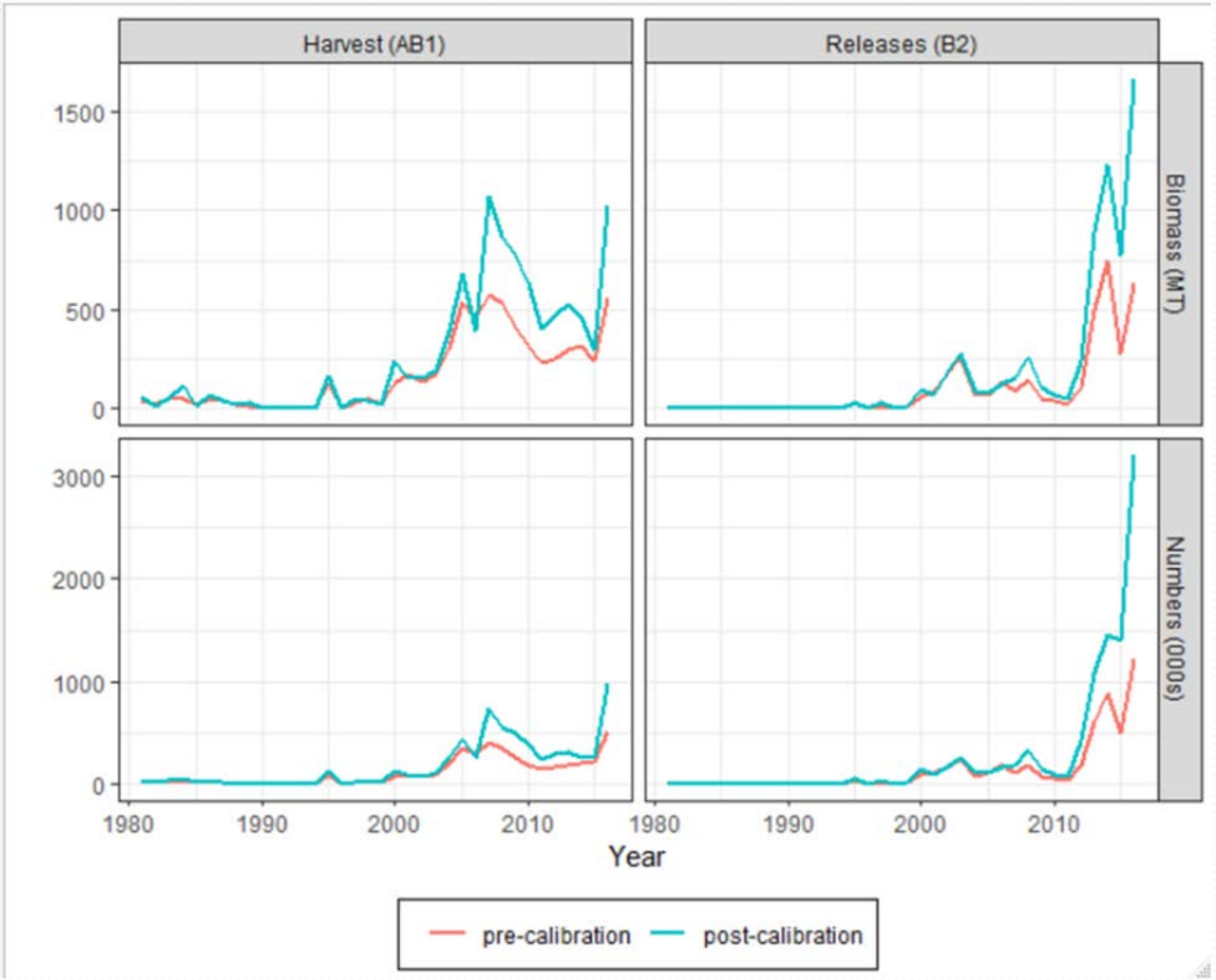


# American Plaice

## Historical Retrospective Age-1 Recruitment



# Gulf of Maine Haddock



# Gulf of Maine Haddock

Total Stock Biomass

| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 350,792 | 228,089 | 232,760 | 223,071 |
| 2 | 1,095,180 | 728,621 | 475,304 | 486,965 |
| 3 | 5,805,188 | 1,529,874 | 1,015,729 | 660,919 |
| 4 | 4,035,744 | 6,626,817 | 1,721,018 | 1,140,654 |
| 5 | 4,543,685 | 4,369,049 | 6,979,430 | 1,805,452 |
| 6 | 78,814,856 | 4,473,065 | 4,136,670 | 6,538,908 |
| 7 | 11,752,131 | 70,795,588 | 3,795,697 | 3,487,564 |
| 8 | 2,171,517 | 10,233,621 | 57,346,612 | 3,041,711 |
| 9+ | 6,773,723 | 7,342,354 | 14,629,480 | 62,200,541 |
| total | 115,342,816 | 106,327,078 | 90,332,700 | 79,585,787 |

Proportions (Total Stock Biomass)

| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.01 | 0.01 | 0.01 | 0.01 |
| 3 | 0.05 | 0.01 | 0.01 | 0.01 |
| 4 | 0.03 | 0.06 | 0.02 | 0.01 |
| 5 | 0.04 | 0.04 | 0.08 | 0.02 |
| 6 | 0.68 | 0.04 | 0.05 | 0.08 |
| 7 | 0.10 | 0.67 | 0.04 | 0.04 |
| 8 | 0.02 | 0.10 | 0.63 | 0.04 |
| 9 | 0.06 | 0.07 | 0.16 | 0.78 |

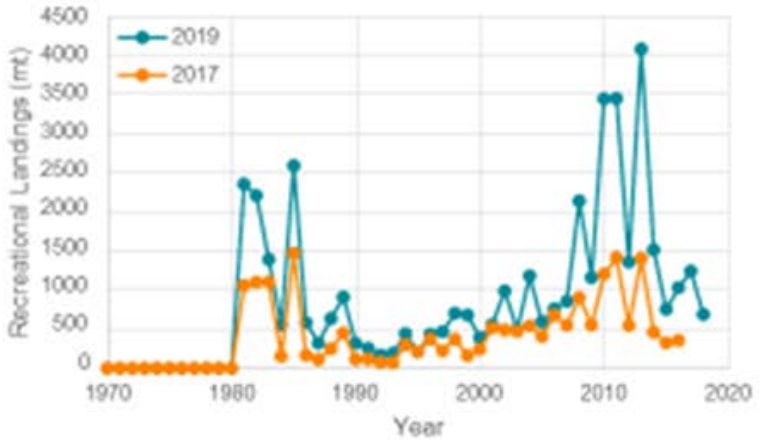
Exploitable Biomass

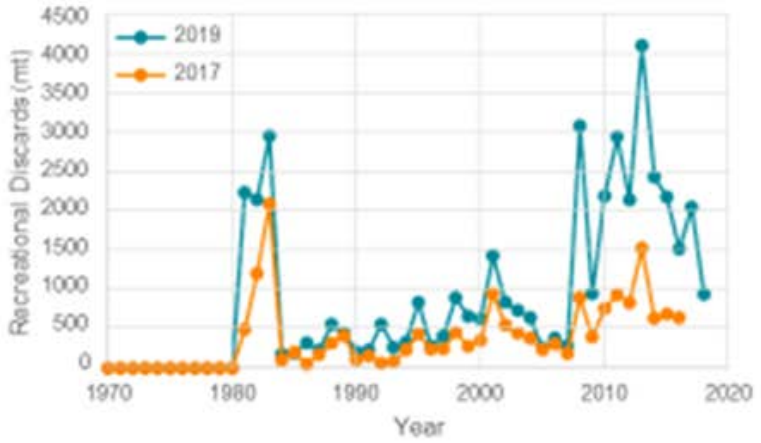
| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 1,052 | 684 | 698 | 669 |
| 2 | 55,854 | 37,160 | 24,240 | 24,835 |
| 3 | 1,056,544 | 278,437 | 184,863 | 120,287 |
| 4 | 1,372,153 | 2,253,118 | 585,146 | 387,822 |
| 5 | 2,412,697 | 2,319,965 | 3,706,077 | 958,695 |
| 6 | 54,145,806 | 3,072,995 | 2,841,892 | 4,492,230 |
| 7 | 10,212,602 | 61,521,366 | 3,298,461 | 3,030,693 |
| 8 | 2,171,517 | 10,233,621 | 57,346,612 | 3,041,711 |
| 9+ | 5,378,336 | 5,829,829 | 11,615,807 | 49,387,230 |
| total | 76,806,561 | 85,547,175 | 79,603,797 | 61,444,173 |

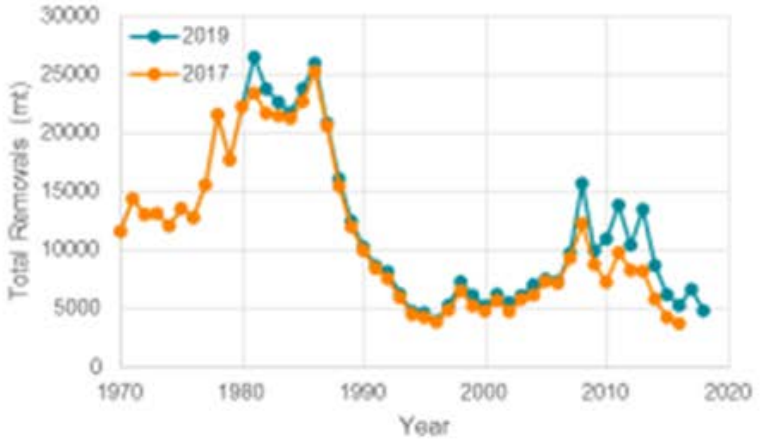
Proportions (Exploitable Biomass)

| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.01 | 0.00 | 0.00 | 0.00 |
| 4 | 0.02 | 0.03 | 0.01 | 0.01 |
| 5 | 0.03 | 0.03 | 0.05 | 0.02 |
| 6 | 0.70 | 0.04 | 0.04 | 0.07 |
| 7 | 0.13 | 0.72 | 0.04 | 0.05 |
| 8 | 0.03 | 0.12 | 0.72 | 0.05 |
| 9 | 0.07 | 0.07 | 0.15 | 0.80 |

# Pollock



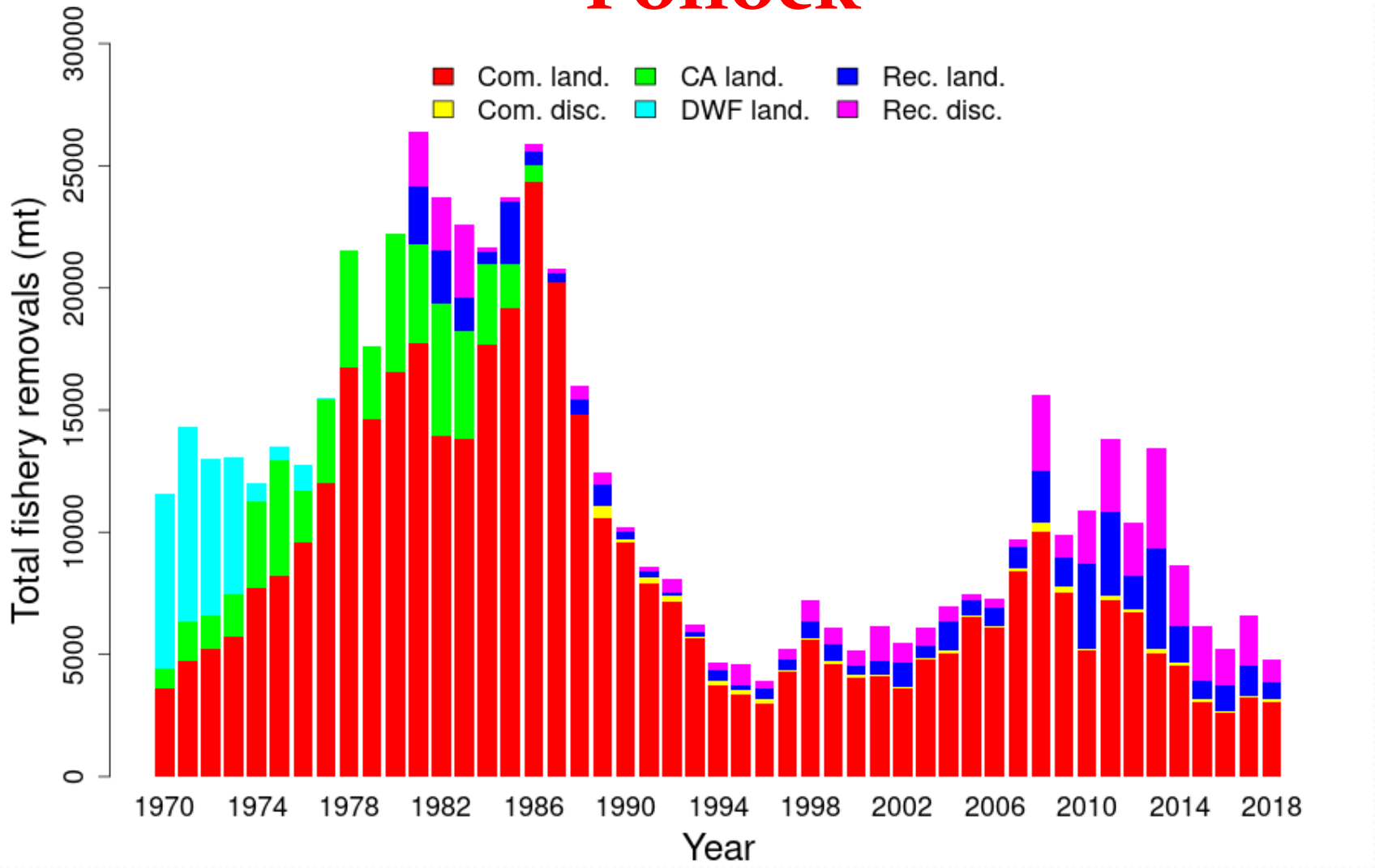



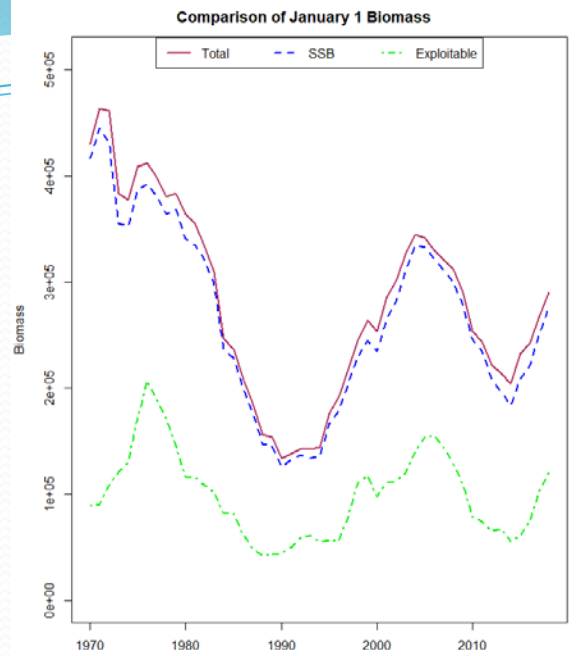

2019 Assessment: 2016 recreational removals account for 49% of total removals

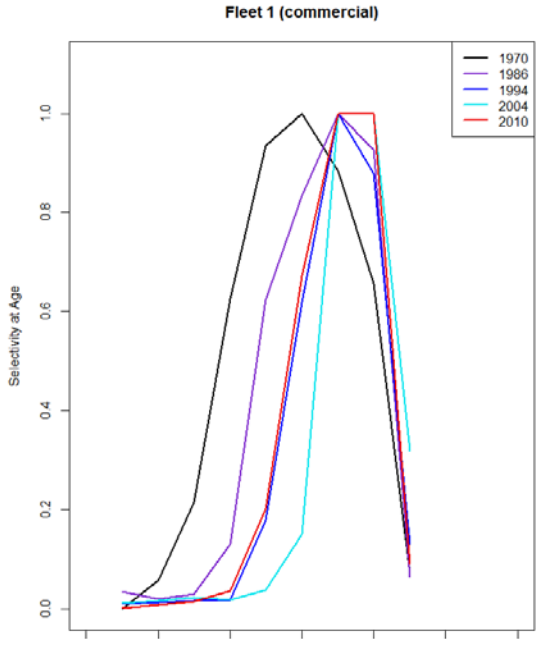
2017 Assessment: 2016 recreational removals account for 27% of total removals

# Pollock

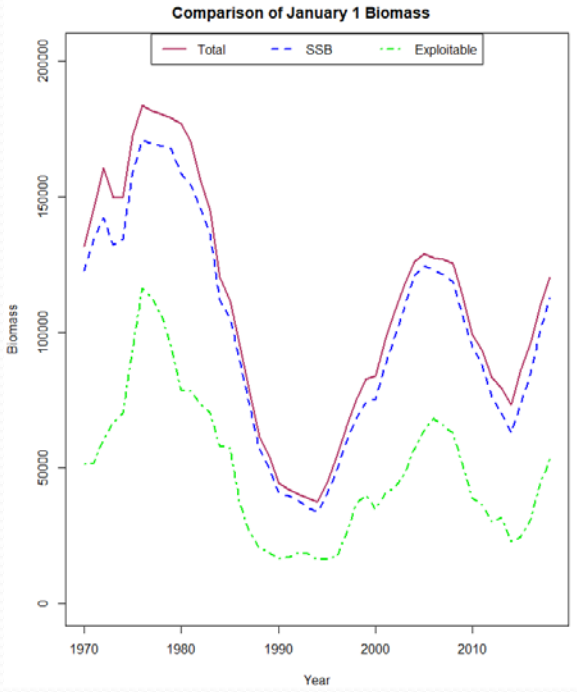

Com. land.
CA land.
Rec. land.
Com. disc.
DWF land.
Rec. disc.
Total fishery removals (mt)
0
5000
10000
15000
20000
25000
30000
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
2018
Year

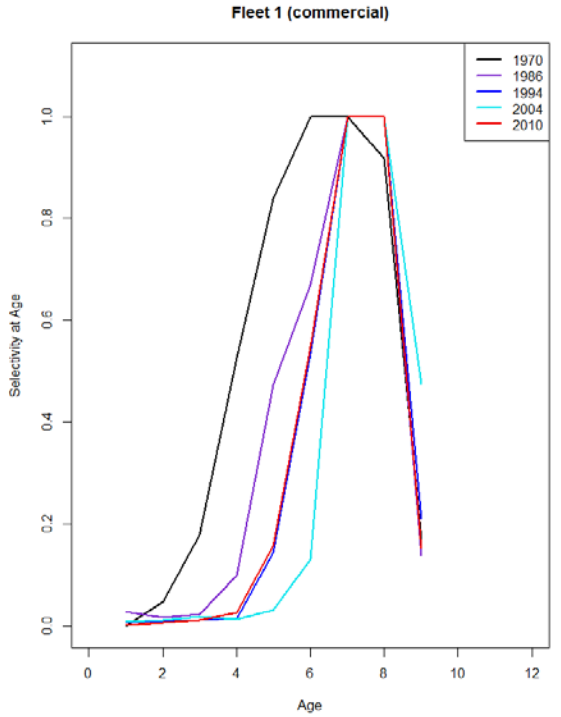
# Pollock




Dome




Flat

# Pollock

Total Stock Biomass

| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 2,834,632 | 2,378,537 | 2,375,821 | 2,373,005 |
| 2 | 2,928,220 | 5,318,805 | 4,438,569 | 4,426,659 |
| 3 | 5,618,610 | 4,930,786 | 8,887,487 | 7,394,611 |
| 4 | 10,963,941 | 9,901,278 | 8,567,938 | 15,411,554 |
| 5 | 22,574,769 | 15,837,764 | 14,002,345 | 12,061,709 |
| 6 | 39,895,521 | 26,573,797 | 17,929,071 | 15,627,373 |
| 7 | 26,987,846 | 40,514,212 | 24,650,709 | 16,305,360 |
| 8 | 24,673,588 | 25,776,530 | 34,206,120 | 20,235,822 |
| 9+ | 62,914,666 | 79,189,673 | 89,396,168 | 105,142,642 |
| total | 199,391,793 | 210,421,382 | 204,454,228 | 198,978,737 |

Proportions (Total Stock Biomass)

| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 0.01 | 0.01 | 0.01 | 0.01 |
| 2 | 0.01 | 0.03 | 0.02 | 0.02 |
| 3 | 0.03 | 0.02 | 0.04 | 0.04 |
| 4 | 0.05 | 0.05 | 0.04 | 0.08 |
| 5 | 0.11 | 0.08 | 0.07 | 0.06 |
| 6 | 0.20 | 0.13 | 0.09 | 0.08 |
| 7 | 0.14 | 0.19 | 0.12 | 0.08 |
| 8 | 0.12 | 0.12 | 0.17 | 0.10 |
| 9 | 0.32 | 0.38 | 0.44 | 0.53 |

Exploitable Biomass

| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 129,894 | 108,994 | 108,869 | 108,740 |
| 2 | 209,224 | 380,033 | 317,139 | 316,288 |
| 3 | 600,214 | 526,737 | 949,416 | 789,938 |
| 4 | 1,784,750 | 1,611,766 | 1,394,720 | 2,508,748 |
| 5 | 7,499,716 | 5,261,570 | 4,651,813 | 4,007,102 |
| 6 | 28,721,086 | 19,130,677 | 12,907,273 | 11,250,264 |
| 7 | 26,987,846 | 40,514,212 | 24,650,709 | 16,305,360 |
| 8 | 22,590,174 | 23,599,985 | 31,317,789 | 18,527,129 |
| 9+ | 8,112,022 | 10,210,471 | 11,526,465 | 13,556,767 |
| total | 96,634,926 | 101,344,444 | 87,824,194 | 67,370,337 |

Proportions (Exploitable Biomass)

| Age | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.01 | 0.01 | 0.01 | 0.01 |
| 4 | 0.02 | 0.02 | 0.02 | 0.04 |
| 5 | 0.08 | 0.05 | 0.05 | 0.06 |
| 6 | 0.30 | 0.19 | 0.15 | 0.17 |
| 7 | 0.28 | 0.40 | 0.28 | 0.24 |
| 8 | 0.23 | 0.23 | 0.36 | 0.28 |
| 9 | 0.08 | 0.10 | 0.13 | 0.20 |