# 18. Partial assessment of the skate stock complex in the Bering Sea and Aleutian Islands

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## Executive Summary

The Bering Sea and Aleutian Islands (BSAI) skate stock complex is managed in aggregate, with a single set of harvest specifications applied to the entire complex. However, to generate the harvest recommendations the stock is divided into two units. Harvest recommendations for Alaska skate *Bathyraja parmifera*, the most abundant skate species in the BSAI, are made using the results of an age structured model and are managed under Tier 3. The remaining species ("other skates") are managed under Tier 5 due to a lack of data. The Tier 3 and Tier 5 recommendations are combined to generate recommendations for the complex as a whole.

BSAI skates are assessed on a biennial stock assessment schedule. A full assessment is conducted in even years and in odd years a partial executive summary update is produced. For 2022, a full assessment was planned but due to staffing resources a partial executive summary update is being provided.

### Summary of Changes in Assessment Inputs

Changes in the input data:

1) Catch data have been updated through October 11, 2022. The 2021 catch data used in the projection model have been updated, and new estimates of 2022 and 2023 catches were created for use in the projection model.
2) Survey biomass estimates from the 2022 eastern Bering Sea (EBS) shelf bottom trawl survey have been included.

Changes in assessment methodology:

There were no changes to the assessment methodology. The projection model for harvest recommendations for Tier 3 Alaska skates was re-run with updated catch data. For the remaining Tier 5 species, the random effects biomass estimate was not updated in this partial assessment.

### Summary of results

1) The trend of lower catches of skates in the BSAI since 2018 continued through 2021 but shows a slight increase in 2022 (Table 1).
2) The 2022 survey biomass estimates for the aggregate skate stock complex on the EBS shelf changed by less than 1% relative to the 2021 values (Table 2).
3) In the NBS, the Alaska skate biomass estimate dropped from around 80 kt to just under 50 kt (Table 3).
4) The rate of skate stock complex harvest relative to ABC has been increasing since 2019, but has decreased since 2017 for the Tier 5 other skates subgroup. In 2021 46.9% of the ABC was harvested. The exploitation rates, catch relative to estimated total biomass, have followed a similar trend. The exploitation rates for the full skate stock complex and Alaska skates were 3.2% in 2021, and for other skates the rate was 2.8% in 2021 (Figure 2).
5) The harvest recommendations for 2023 have changed slightly from last year's assessment resulting in a 1% decrease in ABC, and projection model recommendations for 2024 are included.

| **Alaska skate harvest recommendations** | | | | |
|---|---|---|---|---|
| | As estimated or specified *last* year for: | | As estimated or recommended *this* year for: | |
| Quantity | 2022 | 2023 | 2023* | 2024* |
| *M* (natural mortality rate) | 0.13 | 0.13 | 0.13 | 0.13 |
| Tier | 3a | 3a | 3a | 3a |
| Projected total (age 0+) biomass (t) | 489,868 | 476,753 | 473,527 | 450,679 |
| **Female spawning biomass (t)** | | | | |
| Projected | 121,575 | 115,692 | 114,804 | 105,959 |
| $B_{100\%}$ | 178,425 | 178,425 | 178,425 | 178,425 |
| $B_{40\%}$ | 71,370 | 71,370 | 71,370 | 71,370 |
| $B_{35\%}$ | 62,449 | 62,449 | 62,449 | 62,449 |
| $F_{OFL}$ | .092 | .092 | 0.092 | 0.092 |
| max$F_{ABC}$ | .079 | .079 | 0.079 | 0.079 |
| $F_{ABC}$ | .079 | .079 | 0.079 | 0.079 |
| OFL (t) | 37,073 | 35,758 | 35,503 | 33,451 |
| maxABC (t) | 31,920 | 30,786 | 30,567 | 28,799 |
| ABC (t) | 31,920 | 30,786 | 30,567 | 28,799 |
| | As determined *last* year for: | | As determined *this* year for: | |
| Status | 2020 | 2021 | 2021 | 2022 |
| Overfishing | No | n/a | No | n/a |
| Overfished | n/a | No | n/a | No |
| Approaching overfished | n/a | No | n/a | No |

* The catch data used in the projection model that produces these recommendations are presented in Table 1. The full 2022 catch was set to be equal to the value as at October 10, 2022.

| **other skate harvest recommendations** | | | | |
|---|---|---|---|---|
| | As estimated or specified last year for: | | As estimated or recommended this year for: | |
| Quantity | 2022 | 2023 | 2023 | 2024 |
| *M* (natural mortality rate) | 0.1 | 0.1 | 0.1 | 0.1 |
| Tier | 5 | 5 | 5 | 5 |
| Biomass (t) | 107,174 | 107,174 | 107,174 | 107,174 |
| $F_{OFL}$ | 0.10 | 0.10 | 0.10 | 0.10 |
| max$F_{ABC}$ | 0.075 | 0.075 | 0.075 | 0.075 |
| $F_{ABC}$ | 0.075 | 0.075 | 0.075 | 0.075 |
| OFL (t) | 10,717 | 10,717 | 10,717 | 10,717 |
| maxABC (t) | 8,038 | 8,038 | 8,038 | 8,038 |
| ABC (t) | 8,038 | 8,038 | 8,038 | 8,038 |
| | As determined *last* year for: | | As determined *this* year for: | |
| Status | 2022 | 2020 | 2023 | 2021 |
| Overfishing | No | n/a | No | n/a |

| aggregate harvest recommendations for the BSAI complex | | | | |
|---|---|---|---|---|
| | As estimated or specified *last* year for: | | As estimated or recommended this year for: | |
| Quantity | 2022 | 2023 | 2023 | 2024 |
| OFL (t) | 47,790 | 46,475 | 46,220 | 44,168 |
| maxABC (t) | 39,958 | 38,824 | 38,605 | 36,837 |
| ABC (t) | 39,958 | 38,824 | 38,605 | 36,837 |

## Summaries for Plan Team

| Species | Year | Age 0+ Biomass[1] | OFL | ABC | TAC | Catch |
|---|---|---|---|---|---|---|
| Shark Stock Complex | 2021 | 611,865 | 49,297 | 41,257 | 18,000 | 19,332 |
| | 2022 | 597,042 | 47,790 | 39,958 | 30,000 | 24,181[2] |
| | 2023 | 580,701 | 46,220 | 38,605 | | |
| | 2024 | 557,853 | 44,168 | 36,837 | | |

[1]Sum of Tier 3 Age 0+ biomass and species-specific Tier 5 exploitable biomasses
[2]Catch as of October 11, 2022.

## Responses to SSC and Plan Team Comments on Assessments in General

Comments relevant to this assessment are recorded here and will be responded to at the next full assessment.

*"The SSC supports the JGPT's recommendation that stock assessment authors transition from the ADMB RE variants to the rema framework, which implements the same model variants in a single framework with several improvements."*(SSC, Oct 2022)

## SSC and Plan Team Comments Specific to this Assessment

There were no recommendations from the BSAI Groundfish Plan Team.

"*….. the declining trend of leopard skate is notable, from a high of 11,825 t in 2010 to 2,634 t in 2018. The SSC registers some concern with the decline of this endemic species, and asks if there are any additional data that could be brought forward to attempt to discern if there is a conservation issue associated with this decline."* (SSC December 2020)

"*The SSC suggests that it may be appropriate to update the stock structure template during the next full assessment, with a focus on Alaska skate, as was requested by the SSC in 2018.*" (SSC December 2020)

# Tables

Table 1. Estimated catch (t) of the skate stock complex in the Bering Sea and Aleutian Islands (BSAI). "Official estimate" refers to the catch estimates as of October 10, 2022 maintained by the NMFS Alaska Regional Office in the Catch Accounting System. "Author's species composition" refers to species-specific catch estimates for Alaska skates and the Other Skates group, calculated by the author based on species composition data from surveys (pre-2007) and fisheries (2007-present), represented by the horizontal line between 2006 and 2007. Note that all catch values have been updated from 2003-present.

| | official estimate | author's species composition | |
|---|---|---|---|
| **Year** | **total BSAI skate catch** | **Alaska skate catch** | **Other Skates catch** |
| **1992** | 16,962 | 15,299 | 1,663 |
| **1993** | 12,226 | 11,027 | 1,199 |
| **1994** | 14,223 | 12,829 | 1,394 |
| **1995** | 14,892 | 13,432 | 1,460 |
| **1996** | 12,643 | 11,403 | 1,240 |
| **1997** | 17,747 | 15,991 | 1,756 |
| **1998** | 19,318 | 17,278 | 2,040 |
| **1999** | 14,080 | 12,606 | 1,474 |
| **2000** | 18,877 | 16,417 | 2,460 |
| **2001** | 20,570 | 17,535 | 3,035 |
| **2002** | 21,279 | 19,514 | 1,765 |
| **2003** | 20,270 | 17,466 | 2,804 |
| **2004** | 20,673 | 16,523 | 4,150 |
| **2005** | 21,539 | 17,580 | 3,958 |
| **2006** | 19,094 | 16,047 | 3,048 |
| **2007** | 17,691 | 14,979 | 2,713 |
| **2008** | 20,168 | 14,855 | 5,313 |
| **2009** | 19,008 | 15,448 | 3,560 |
| **2010** | 17,066 | 13,191 | 3,875 |
| **2011** | 22,897 | 18,102 | 4,795 |
| **2012** | 23,603 | 18,738 | 4,865 |
| **2013** | 25,852 | 21,269 | 4,583 |
| **2014** | 26,190 | 20,383 | 5,807 |
| **2015** | 26,989 | 20,517 | 6,472 |
| **2016** | 27,654 | 22,051 | 5,603 |
| **2017** | 30,401 | 23,706 | 6,694 |
| **2018** | 29,634 | 23,570 | 6,064 |
| **2019** | 19,197 | 15,130 | 4,066 |
| **2020** | 18,239 | 14,779 | 3,460 |
| **2021** | 19,332 | 16,318 | 3,014 |
| ***2022**** | *24,181* | *21,381* | *2,801* |

* 2022 catch data are incomplete; data retrieved on October 10, 2022.

Table 2. Biomass estimates, 1999-2022, from the NMFS eastern Bering Sea (EBS) shelf bottom trawl survey for the major skate species found on the shelf. CV = coefficient of variation. No bottom trawl surveys were conducted in 2020 due to the coronavirus pandemic.

| | **big** | | **Bering** | | **Aleutian** | | **Alaska** | |
|---|---|---|---|---|---|---|---|---|
| | **biomass** | **CV** | **biomass** | **CV** | **biomass** | **CV** | **biomass** | **CV** |
| **1999** | 6,523 | 1.00 | 9,344 | 0.20 | 0 | | 321,732 | 0.17 |
| **2000** | 5,182 | 0.83 | 16,750 | 0.16 | 2,219 | 0.54 | 311,652 | 0.06 |
| **2001** | 1,820 | 0.78 | 14,130 | 0.14 | 1,208 | 0.61 | 413,816 | 0.06 |
| **2002** | 1,498 | 0.59 | 12,655 | 0.16 | 2,875 | 0.47 | 363,236 | 0.07 |
| **2003** | 0 | | 13,520 | 0.12 | 18,043 | 0.43 | 372,100 | 0.05 |
| **2004** | 952 | 0.71 | 11,127 | 0.12 | 2,474 | 0.41 | 424,508 | 0.05 |
| **2005** | 2,324 | 0.71 | 8,705 | 0.17 | 8,191 | 0.56 | 487,010 | 0.05 |
| **2006** | 1,041 | 0.68 | 11,604 | 0.13 | 5,512 | 0.41 | 437,468 | 0.05 |
| **2007** | 1,812 | 0.76 | 9,426 | 0.14 | 2,699 | 0.43 | 479,235 | 0.07 |
| **2008** | 2,887 | 0.63 | 9,878 | 0.16 | 6,215 | 0.57 | 361,585 | 0.06 |
| **2009** | 4,504 | 0.50 | 13,158 | 0.18 | 2,157 | 0.49 | 350,384 | 0.06 |
| **2010** | 3,473 | 0.66 | 11,903 | 0.14 | 3,286 | 0.35 | 366,930 | 0.06 |
| **2011** | 5,288 | 0.72 | 9,702 | 0.17 | 2,513 | 0.54 | 410,961 | 0.05 |
| **2012** | 1,166 | 0.70 | 10,108 | 0.16 | 4,517 | 0.37 | 370,249 | 0.06 |
| **2013** | 3,395 | 1.00 | 11,953 | 0.28 | 11,341 | 0.35 | 387,225 | 0.06 |
| **2014** | 3,614 | 0.60 | 12,484 | 0.15 | 8,045 | 0.41 | 405,036 | 0.05 |
| **2015** | 15,550 | 0.49 | 12,138 | 0.13 | 10,940 | 0.40 | 448,213 | 0.06 |
| **2016** | 10,745 | 0.54 | 10,918 | 0.12 | 14,252 | 0.27 | 550,912 | 0.04 |
| **2017** | 13,762 | 0.41 | 15,135 | 0.17 | 36,603 | 0.56 | 545,059 | 0.07 |
| **2018** | 28,913 | 0.42 | 14,498 | 0.11 | 18,708 | 0.33 | 546,263 | 0.05 |
| **2019** | 11,902 | 0.37 | 10,044 | 0.12 | 14,722 | 0.27 | 490,420 | 0.05 |
| **2020** | | | | | | | | |
| **2021** | 13,627 | 0.42 | 12,168 | 0.12 | 17,450 | 0.26 | 468,113 | 0.05 |
| **2022** | 14,179 | 0.44 | 12,803 | 0.14 | 18,040 | 0.24 | 463,017 | 0.06 |

Table 3. Survey biomass estimates (t) of Alaska skate in the northern Bering Sea, 2010-2022. Estimates are from the northern Bering Sea bottom trawl survey that extends north from the historical eastern Bering Sea shelf survey area. CV = coefficient of variation.

| | biomass | CV |
|---|---|---|
| 2010 | 76,942 | 0.19 |
| 2017 | 83,255 | 0.14 |
| 2019 | 95,102 | 0.15 |
| 2021 | 80,207 | 0.20 |
| 2022 | 48,920 | 0.14 |

# Figures

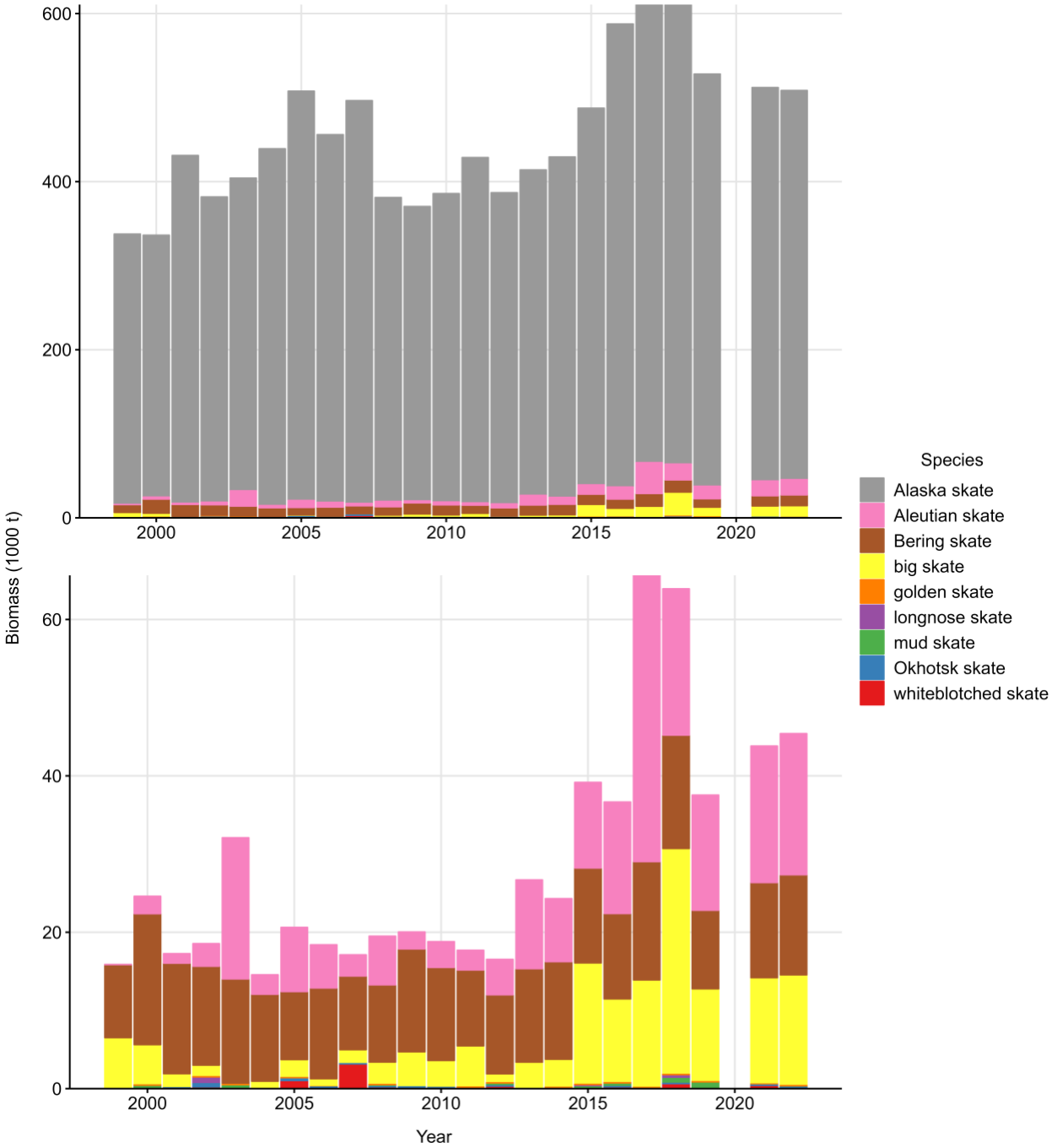


Figure 1. Species composition of survey biomass estimates for skates on the eastern Bering Sea shelf (EBS) by year from 1999-2022. Total biomass (t) is displayed for the assemblage either with (top) or without (bottom) Alaska skate, which is the dominant species. Data are from the NMFS EBS shelf bottom trawl survey; vertical scales differ between plots. No survey was conducted in 2020 due to the coronavirus pandemic.

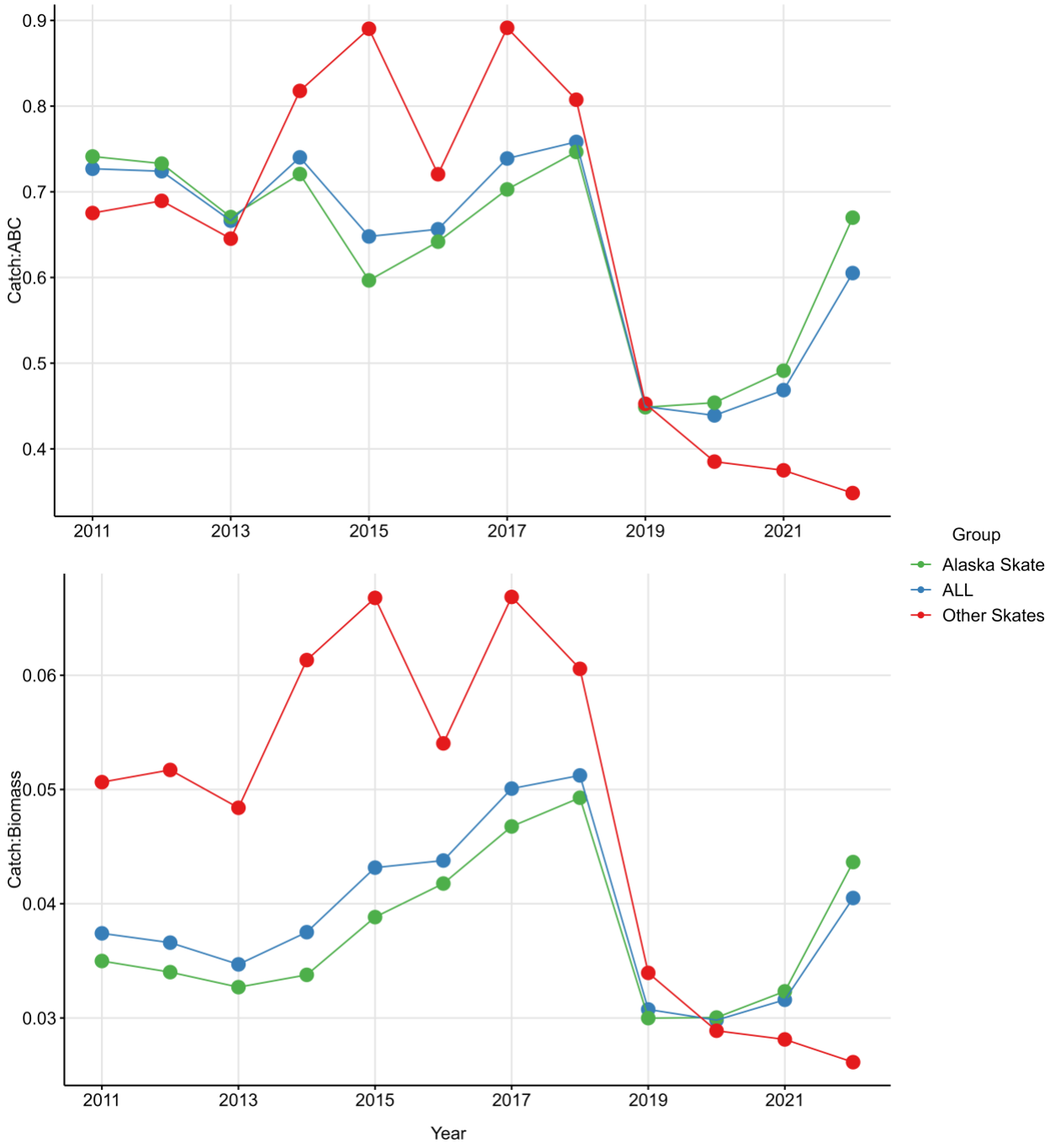


Figure 2. Catch relative to ABC (top) and biomass (bottom). The "All" group is at the complex level, i.e., management units. The Alaska skate and other skates are the Tier 3 and Tier 5 sub-groups of the BSAI skate stock complex, respectively.