# 4. Assessment of the Shallow-water Flatfish Stock Complex in the Gulf of Alaska

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## Executive Summary

The shallow-water flatfish stock complex in the Gulf of Alaska (GOA) includes Alaska plaice (*Pleuronectes quadrituberculatus*), butter sole (*Pleuronectes isolepis*), English sole (*Parophrys vetulus*), sand sole (*Psettichthys melanostictus*), starry sole, yellowfin sole (*Pleuronectes asper*), northern rock sole (*Lepidopsetta ploystra*), and southern rock sole (*Lepidopsetta bilineata*). Northern and southern rock sole are tier 3 species and assessed separately from the other shallow-water flatfish. The shallow-water flatfish stock complex has been moved to a 4-year assessment cycle. Last year, 2017, was the first year of the new schedule and a full assessment was completed. This year a partial assessment was done.

The 2017 assessment of the shallow-water flatfish complex excluding northern and southern rock sole used a random effects model to estimate current biomass (for details see Spencer, et al. 2013). Last year the random effects model was fit to survey biomass for 1984 to 2017, leaving out 2001 where the Eastern area was not surveyed. The survey biomass for each year was summed over species (not including rock sole). The apportionment by area was estimated by fitting the random effects model to the survey biomass summed for all species (including rock sole) by area and then estimating the percent biomass in the ending year by area. The percent biomass by species (excluding rock sole) was estimated using the random effects model fit to survey biomass by species and dividing by the total from the fit by species. The random effects model was not run in 2018 because it was an off year for the GOA trawl survey. The estimates from the 2017 assessment were used this year to estimate the OFL and ABC for 2019 and 2020.

### *Summary of Changes in Assessment Inputs*

*Changes in the input data:* There were no changes made to the input data since this was an off-cycle year.

*Changes in assessment methodology:* There were no changes made to the random effects model. Therefore, the estimates of ABC and OFL for all shallow-water flatfish species except northern and southern rock sole are the same as those recommended last year. Differences are due to the estimates for northern and southern rock sole (Bryan 2018).

### *Summary of Results*

The recommended maximum allowable ABC for the shallow-water flatfish stock complex is 55,587 t. This represents a 2% increase from the specified 2018 ABC. The 2019 ABC is less than 1% larger than the projected 2019 ABC from last year. The following table summarizes the reference values and the recommended ABC and OFL values in bold. Overfishing is not occurring.

Figure 4.1 summarizes the derived exploitation rates for shallow-water flatfish excluding northern and southern rock sole. Butter sole have had the highest exploitation rates of shallow-water. Butter sole exploitation peaked in 2010 at 0.1 and has generally declined since. In 2013, exploitation was 0.06, in 2016 exploitation was 0.03, and 2017 it was 0.011.

| Quantity | As estimated or *specified last* year for: 2018 | 2019 | As estimated or *recommended this* year for: 2019 | 2020 |
|---|---|---|---|---|
| *M* (natural mortality rate)[1] | 0.2 | 0.2 | 0.2 | 0.2 |
| Tier | 3a and 5 | 3a and 5 | 3a and 5 | 3a and 5 |
| Biomass (t) | 339,152 | 343,018 | 343,755 | 345,304 |
| $F_{OFL}$ | * | * | * | * |
| $maxF_{ABC}$ | * | * | * | * |
| $F_{ABC}$ | * | * | * | * |
| OFL (t) | 67,240 | 68,114 | **68,309** | 69,167 |
| maxABC (t) | 54,688 | 55,422 | **55,587** | 56,308 |
| ABC (t) | 54,688 | 55,422 | **55,587** | 56,308 |
| **Status** | As determined *last* year for: 2016 | 2017 | As determined *this* year for: 2017 | 2018 |
| Overfishing | No | NA | No | NA |

* See Bryan et al. 2018 for values for northern and southern rock sole. [1] Northern rock sole male M=0.253, southern rock sole male M= 0.262, all other M=0.2

There were no changes made to the random effects model in 2018. Therefore, the estimates of ABC and OFL for all shallow-water flatfish species except northern and southern rock sole are the same as those recommended for last year. Differences in the 2019 ABC and OFL estimates are due to the estimates for northern and southern rock sole (Bryan 2018). The following table summarizes the species-specific recommendations.

| Species | | | | | | As *specified last* year for: 2018 | | 2019 | | As *recommended this* year for: 2019 | | 2020 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shallow-water flatfish | Tier | FABC | FOFL | 2019 Biomass[1] | 2020 Biomass1 | ABC | OFL | ABC | OFL | ABC | OFL | ABC | OFL |
| Northern rock sole | 3a | 0.242 | 0.287 | 93,748 | 94,029 | 16,802 | 19,960 | 17,243 | 20,477 | 17,331 | 20,582 | 17,548 | 20,836 |
| Southern rock sole | 3a | 0.271 | 0.326 | 140,270 | 141,538 | 21,424 | 25,333 | 21,717 | 25,689 | 21,794 | 25,779 | 22,298 | 26,383 |
| Yellowfin sole | 5 | 0.15 | 0.2 | 35,284 | 35,284 | 5,293 | 7,057 | 5,293 | 7,057 | 5,293 | 7,057 | 5,293 | 7,057 |
| Butter sole | 5 | 0.15 | 0.2 | 16,368 | 16,368 | 2,455 | 3,274 | 2,455 | 3,274 | 2,455 | 3,274 | 2,455 | 3,274 |
| Starry flounder | 5 | 0.15 | 0.2 | 29,474 | 29,474 | 4,421 | 5,895 | 4,421 | 5,895 | 4,421 | 5,895 | 4,421 | 5,895 |
| English sole | 5 | 0.15 | 0.2 | 16,210 | 16,210 | 2,432 | 3,242 | 2,432 | 3,242 | 2,432 | 3,242 | 2,432 | 3,242 |
| Sand sole | 5 | 0.15 | 0.2 | 1,511 | 1,511 | 227 | 302 | 227 | 302 | 227 | 302 | 227 | 302 |
| Alaska plaice | 5 | 0.15 | 0.2 | 10,890 | 10,890 | 1,634 | 2,178 | 1,634 | 2,178 | 1,634 | 2,178 | 1,634 | 2,178 |
| Total | | | | 343,755 | 345,304 | 54,688 | 67,241 | 55,422 | 68,114 | 55,587 | 68,309 | 56,308 | 69,167 |

[1] 2017 estimate from random effects model fit to survey biomass estimates except northern and southern rock sole. Total biomass of northern and southern rock sole is the age 0+ biomass from the projection model (Bryan 2018).

### Area Apportionment

The apportionment percentages are the same as in the 2018 assessment from the random effects model estimates of biomass for the shallow water flatfish complex. The following table shows the recommended rounded apportionment percentages.

| | Western | Central | Yakutat | Southeast |
|---|---|---|---|---|
| Proportions | 0.46 | 0.46 | 0.04 | 0.04 |

The recommended 2018 and 2019 shallow-water flatfish ABC and OFL levels with tier 3a estimates from projections run with the 2017 model for northern and southern rock sole (see Bryan, et al. 2017 and Bryan 2018):

| | | 2018 | | | | 2019 | | 2020 | |
|---|---|---|---|---|---|---|---|---|---|
| **Stock/Assemblage** | **Area** | **OFL** | **ABC** | **TAC** | **Catch[1]** | **OFL** | **ABC** | **OFL** | **ABC** |
| Shallow-water flatfish | W | -- | 25,206 | 13,250 | 31 | -- | 25620 | -- | 25,952 |
| | C | -- | 25,315 | 25,315 | 2,197 | -- | 25731 | -- | 26,065 |
| | WYAK | -- | 2,242 | 2,242 | <1 | -- | 2279 | -- | 2,308 |
| | SEO | -- | 1,925 | 1,925 | <1 | -- | 1957 | -- | 1,982 |
| | Total | 67,240 | 54,688 | 42,732 | | 68,309 | 55,587 | 69,167 | 56,308 |

[1]As of Oct. 31, 2018.

### Figures

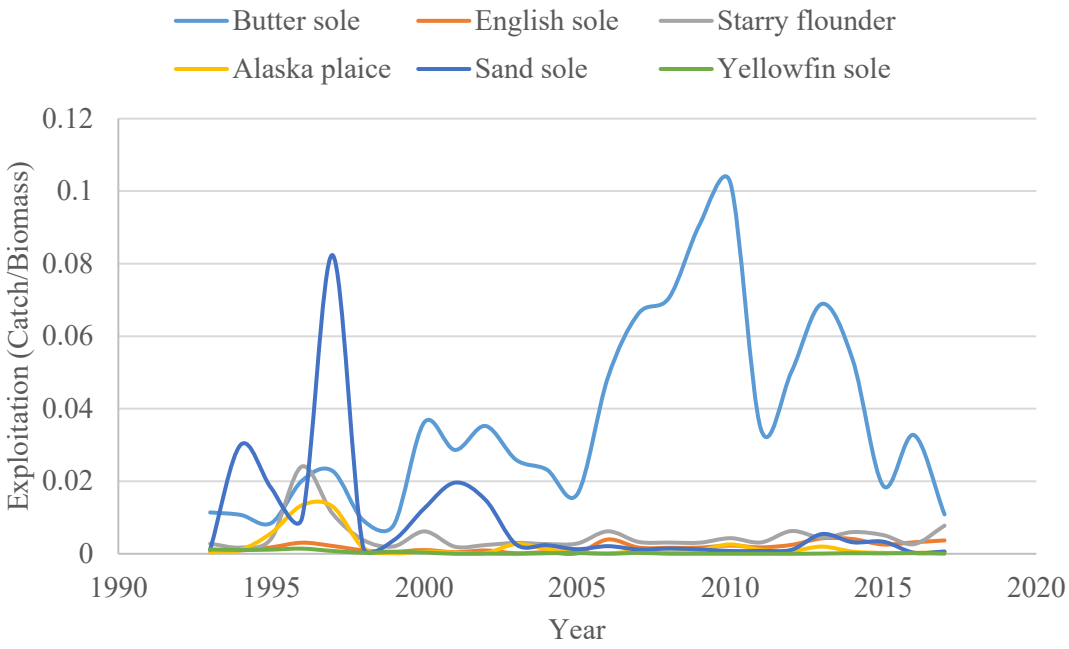


Figure 4.1. Exploitation rates for shallow-water flatfish not including northern and southern rock sole from 1991 until 2017.

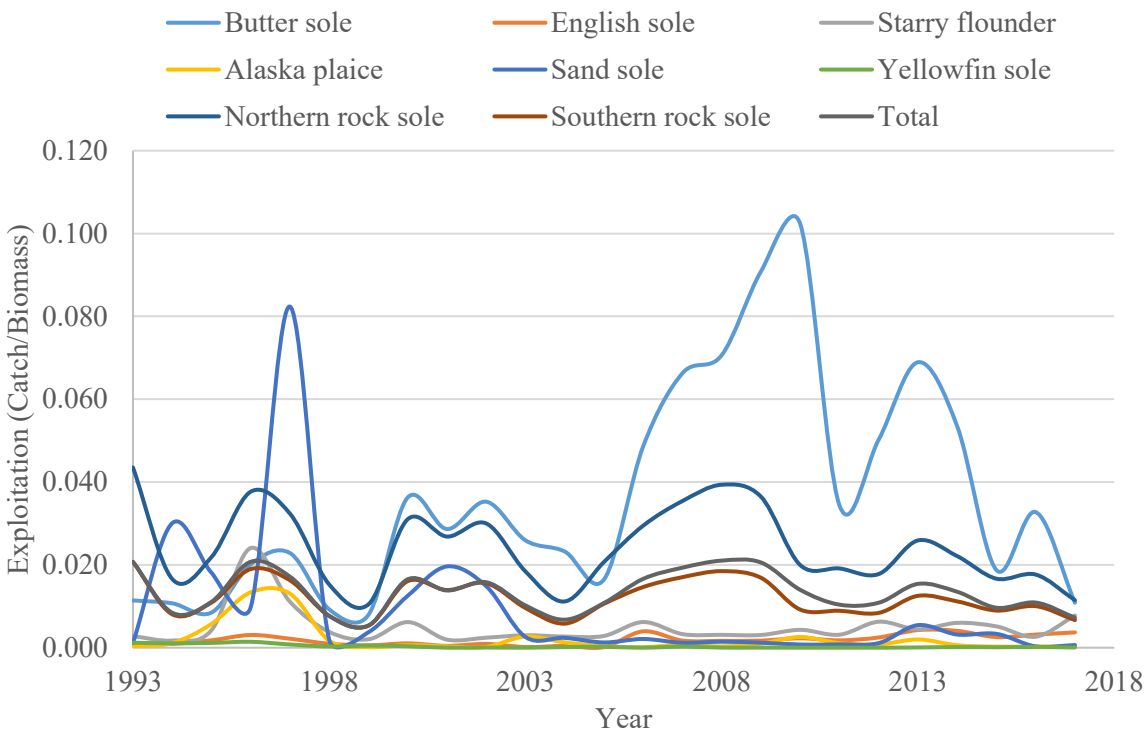


Figure 4.2. Exploitation rates for shallow-water flatfish including northern and southern rock sole from 1991 until 2017.

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

SSC (Oct 2016): "The SSC reminds groundfish and crab stock assessment authors to follow their respective guidelines for SAFE preparation."

*Authors' response*: SAFE guidelines were followed.

### *Responses to SSC and Plan Team Comments Specific to this Assessment*

There were no specific comments for this assessment from 2017. Comments directed towards northern and southern rock sole are addressed in Bryan (2018).

## References

Bryan, M and W. Palsson. 2018. Assessment of the northern and southern rock sole (*Lepidopsetta polyxystra and bilineata*) stocks in the Gulf of Alaska for 2018. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.

Bryan, M, Z.T. A'mar and W. Palsson. 2017. Assessment of the northern and southern rock sole (*Lepidopsetta polyxystra and bilineata*) stocks in the Gulf of Alaska for 2017. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.

Spencer, P., J. Ianelli, G. Thompson, J. Heifetz. 2013. Report of the working group on methods for averaging surveys: *Updated through 2013.* Unpublished report.