5. Assessment of the Deepwater Flatfish Stock Complex in the Gulf of Alaska

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Executive Summary

The Gulf of Alaska deepwater flatfish complex (consisting of Dover sole, Greenland turbot, and deepsea sole) is assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. For Gulf of Alaska deepwater flatfish, in alternate (even) years we present an executive summary to recommend harvest levels for the next two years. Please refer to last year's full stock assessment report for further information regarding the assessment model (McGilliard et al., 2015, available online at http://www.afsc.noaa.gov/REFM/Docs/2015/GOAdeepflat.pdf). A full stock assessment document with updated assessment and projection model results will be presented in next year's SAFE report.

Dover sole is assessed using an age-structured model and Tier 3 determination. Thus, the single species projection model was run using parameter values from the accepted 2015 Dover sole assessment model (McGilliard and Palsson 2015), together with updated catch information for 2015 and 2016, to predict stock status for Dover sole in 2017 and 2018 and to make ABC recommendations for those years. Greenland turbot and deepsea sole fall under Tier 6. ABC's and OFL's for Tier 6 species are based on historical catch levels and therefore these quantities cannot be updated. ABC's and OFL's for the individual species in the deepwater flatfish complex are determined only as an intermediate step for the purpose of calculating complex-level OFL's and ABC's.

Summary of Changes in Assessment Inputs

Changes in the input data: There were no changes made to the assessment model inputs since this was an off-cycle year. New information available to update the Dover sole projection model consists of the total catch for 2015 (256 t) and the current catch for 2016 (170 t as of October 8, 2016). To run the projection model to predict ABC's for 2017 and 2018, estimates are required for the total catches in 2016 and 2017. The final catch for 2016 was estimated by taking the average tons caught between October 8 and December 31 over the previous 5 years (2011-2015) and adding this average amount to the catch-to-date as of October 8 for 2016. The estimated final catch for 2016 was 207 t. The 2017 catch was estimated as the average of the total catch in each of the last 5 years (2011-2015). The estimated catch for 2017 was 316 t.

Changes in assessment methodology: There were no changes in assessment methodology since this was an off-cycle year.

Summary of Results

As in previous years (McGilliard et al. 2015), the species-level ABC is 179 t for Greenland turbot and the OFL is 238 t for both 2017 and 2018. The species-level ABC for deepsea sole is 4 t and the OFL is 6 t for both 2017 and 2018. The species-level ABC for Dover sole is 9,109 t in 2017 and 9,199 t in 2018 and the OFL is 10,938 t in 2017 and 11,046 t in 2018.

Based on the updated projection model results, the recommended complex-level ABC's for 2017 and 2018 are 9,292 t and 9,382 t, and the OFL's are 11,192 t and 11,290 t. The new ABC recommendation and OFL for 2017 are similar to those developed using the 2015 full assessment model (9,280 t and 11,168 t). The principal reference values are shown in the following table:

Species	Quantity	As estimated or *specified last* year for: 2016	2017	As estimated or *recommended this* year for: 2017*	2018*
Dover sole	*M* (natural mortality rate)	0.085	0.085	0.085	0.085
	Tier	3a	3a	3a	3a
	Projected total (3+) biomass (t)	141,824	143,007	143,333	144,611
	Projected Female spawning biomass (t)	49,179	49,271	49,331	49,347
	$B_{100\%}$	57,871	57,871	57,871	57,871
	$B_{40\%}$	23,148	23,148	23,148	23,148
	$B_{35\%}$	20,255	20,255	20,255	20,255
	F_{OFL}	0.12	0.12	0.12	0.12
	$maxF_{ABC}$	0.1	0.1	0.1	0.1
	F_{ABC}	0.1	0.1	0.1	0.1
	OFL (t)	10,858	10,924	10,938	11,046
	maxABC (t)	9,043	9,097	9,109	9,199
	ABC (t)	9,043	9,097	9,109	9,199
Greenland turbot	Tier	6	6	6	6
	OFL (t)	238	238	238	238
	maxABC (t)	179	179	179	179
	ABC (t)	179	179	179	179
Deepsea sole	Tier	6	6	6	6
	OFL (t)	6	6	6	6
	maxABC (t)	4	4	4	4
	ABC (t)	4	4	4	4
Deepwater Flatfish Complex	OFL (t)	11,102	11,168	11,182	11,290
	maxABC (t)	9,226	9,280	9,292	9,382
	ABC (t)	9,226	9,280	9,292	9,382
	Status	As determined in 2015 for: 2014	2015	As determined in 2016 for: 2015	2016
	Overfishing	no	n/a	no	n/a
	Overfished	n/a	no	n/a	no
	Approaching overfished	n/a	no	n/a	no

*Projections are based on estimated catches of 207 t and 316 t used in place of maximum permissible ABC for 2016 and 2017, as well as the final catch for 2015 of 256 t.

Area Apportionment

Area apportionment for ABC of deepwater flatfish is currently based on the relative survey biomass of each of the three species in the complex found within each management area from 2003-2015. An ABC exists only at the level of the complex (deepwater flatfish) and not for each species individually.

Species	Year	Western	Central	West Yakutat	Southeast	Total
		2.0%	37.9%	32.5%	27.6%	100.0%
Deepwater Flatfish	2017	187	3,521	3,018	2,566	9,292
	2018	189	3,555	3,047	2,591	9,382

An alternative method for calculating apportionment for the deepwater flatfish complex is presented in the table below. This method uses the random effects model to fill in depth and area gaps in the survey biomass by area of Dover sole and uses the resulting proportion of predicted survey biomass in each area in 2017 and 2018 as the basis for apportionment of the Dover sole portion of the deepwater complex. The Greenland turbot and deepsea sole portion of the apportionment is based on the relative proportion of survey biomass of each of these individual species found in each area, averaged over the years 2005-2015. The ABC by area for the deepwater flatfish complex is then the sum of the species-specific portions of the ABC.

Species	Year	Western	Central	West Yakutat	Southeast	Total
		0.9%	37.9%	33.1%	28.2%	100.0%
Dover Sole	2017	77	3,451	3,016	2,565	9,109
	2018	78	3,485	3,046	2,590	9,199
		100.0%	0.0%	0.0%	0.0%	100.0%
Greenland Turbot	2017	179	0	0	0	179
	2018	179	0	0	0	179
		0.8%	73.4%	13.8%	12.0%	100.0%
Deepsea Sole	2017	0	3	1	0	4
	2018	0	3	1	0	4
Deepwater Flatfish	**2017**	**256**	**3,454**	**3,017**	**2,565**	**9,292**
	2018	**257**	**3,488**	**3,047**	**2,590**	**9,382**

The first apportionment method is straightforward and simple and is able to account for differences in the spatial distribution of Dover sole and Greenland turbot. The second method is less simple, but accounts for time and area gaps in the survey for Dover sole, which comprises nearly all of the deepwater flatfish catch, and more explicitly accounts for differences in the spatial distributions of Dover sole and Greenland turbot. The second method assigns a larger ABC to the Western region of the GOA, where few Dover sole are found; Greenland turbot have been found exclusively in the Western region by the survey over the period 2005-2015.

Responses to SSC and Plan Team Comments on Assessments in General

SSC, December 2015: The SSC reminds the authors and PTs to follow the model numbering scheme adopted at the December 2014 meeting.
Author Response: The author will follow the new numbering scheme in the next full assessment.

SSC, December 2015: Many assessments are currently exploring ways to improve model performance by re-weighting historic survey data. The SSC encourages the authors and PTs to refer to the forthcoming CAPAM data-weighting workshop report.
Author Response: Two data-weighting methods that were discussed at the CAPAM data-weighting workshop have been applied to GOA Dover sole previously: the Francis data-weighting method (Francis 2011) and the McAllister and Ianelli method (McAllister and Ianelli 1997). Developers of Stock Synthesis are working on adding additional distributions for age- and length-composition likelihood components that may better address data-weighting. The author will follow future developments and apply best available practices for future assessments.

Responses to SSC and Plan Team Comments Specific to this Assessment

GPT, Nov. 2015: The Team recommends the author explore alternative apportionment strategies for the overall deepwater flatfish complex that will better represent Greenland turbot and deepsea sole distribution in the GOA.
Author Response: The author explored alternative apportionment strategies for the deepwater flatfish complex and presented two apportionment strategies in this SAFE document.

Data Gaps and Research Priorities

The 2015 stock assessment incorporated ageing error by using an existing ageing error matrix for West Coast Dover sole. A priority for future assessments is to analyze ageing error data for GOA Dover sole using methods described in Punt et al. (2008) and to incorporate a resulting ageing error matrix into the assessment. The assessment would benefit from an exploration of ways to better account for scientific uncertainty, especially uncertainty associated with parameters that are currently fixed in the model.

Literature Cited

McGilliard, C.R. and Palsson, W. 2015. 5. Gulf of Alaska Deepwater Flatfish. In Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska. pp. 563-624. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage AK 99510.

Punt, A.E., Smith, D.C., Krusic-Golub, K., Robertson, S. 2008.Quantifying age-reading error for use in fisheries stock assessments, with application to species in Australia's southern and eastern scalefish and shark fishery. Can. J. Fish. Aquat. Sci. 65(9): 1991-2005.