Northwest Atlantic Fisheries Organization

Serial No. N7397 **NAFO SCR Doc. 23/010REV_ADD**

SCIENTIFIC COUNCIL MEETING – JUNE 2023

ADDENDUM TO:

Results for Greenland Halibut Candidate Management Procedure Trials

by RA Rademeyer and DS Butterworth

Summary

The results of the trials of a CMP including the EU 3L survey are reported for a base case and six robustness trials developed from SCAA-based Operating Models. Performance is very similar to that for the retuned MP in the main text – slightly less risk and slightly less catch (about 1%).

Introduction

CMP23_NW is modified to include the EU 3L survey results in the TAC computation (CMP23_3L). Equation A3 of the main paper is updated to include six surveys instead of five (EU 3L together with Canada Fall 2J3K, EU 3M 0-1400m, Canada Spring 3LNO, EU 3NO and Canada Fall 3LNO):

$$J_y = \sum_{i=1}^{6} \frac{1}{(\sigma^i)^2} \frac{J^i_{curr,y}}{J^i_{target}} \Big/ \sum_{i=1}^{6} \frac{1}{(\sigma^i)^2} \qquad (1)$$

The estimated variances and related weights given to each surveys ($\frac{1}{(\sigma^i)^2}$) are those estimated in the sensitivity OM6 fit which includes the EU 3L survey. These are compared to the "New" weights estimated in the fit to OM1 in Table Add1 below.

For the OMs that don't fit to the 3L survey, the variance and selectivity estimated in OM6 are used for the projections.

As for CMP23_NW, CMP23_3L is tuned so that the projected median $\frac{B^{5-9}_{2044}}{B^{5-9}_{MSY}}$=1 using the μ tuning parameter (Table Add2).

Results

The performance measures for CMP23_NW and CMP23_3L are compared in **Table Add3** for all OMs, with some of the performance measures compared graphically in **Figure Add1**.

Medians and lower 10%iles for projected catch, spawning and exploitable biomass (both relative to B_{MSY}) and F/F_{MSY} (for which the upper 10%iles are plotted instead of lower 10%iles) are compared under both CMPs for OM1 to OM3 and OM4 to OM6 in **Figures Add2a** and **b** respectively.

Discussion

CMP23-NW and CMP23_3L show very little difference in terms of projected performance. CMP23_3L provides a very slightly better protection of the resource at the expense of a very slightly lower catch (by about 1%).

Table 1. Variances (shown as standard deviations of log residuals) of the survey data series about the expected abundance trend, together with the related weights and weight ratios given to each survey in the MP TAC formula for the SCAA Base Case (used for projections under CMP23_NW) and the SCAA sensitivity adding the 3L survey "OM6" (used for projections under CMP23_3L).

	σ_i		$w_i=1/\sigma_i^2$		w_i ratios	
	2023 OM1	2023 OM6	2023 OM1	2023 OM6	2023 OM1	2023 OM6
Can 2J3K autumn	0.205	0.230	23.715	18.962	0.395	0.258
Can 3LNO spring	0.491	0.490	4.143	4.162	0.069	0.057
Can 3LNO autumn	0.260	0.254	14.845	15.495	0.247	0.211
EU 3M 0-1400m	0.294	0.299	11.558	11.191	0.192	0.153
EU 3L	-	0.239	-	17.464	-	0.238
EU 3NO	0.416	0.405	5.787	6.099	0.096	0.083

Table Add2: Tuning parameters for the CMPs considered in this addendum. The parameters that are adjusted to achieve a median biomass equal to Bmsy for the exploitable component of the resource biomass in 2044, rather than being pre-fixed, are shown in **bold.**

	μ	γ	α	λ_{up}	λ_{down}	X	Δ_{up}	Δ_{down}
CMP23_NW	**0.9890**	0.15	0.9720	1.00	2.00	-0.0056	0.1	0.1
CMP23_3L	**0.9792**	0.15	0.9720	1.00	2.00	-0.0056	0.1	0.1

Table Add3: Performance measures for CMP23_NW and CMP23_3L for the different OMs; the pink highlights show instances where a desired performance criterion specified during the April WG-RBMS meeting (NAFO, 2023) has not been met. Values shown in **bold** indicate that the tuning parameter γ was adjusted to achieve that result for that OM/CMP combination.

	Management objective	1. Restore to within a prescribed period of time or maintain at Bmsy				2. The risk of failure to meet the Bmsy target and interim biomass targets within a prescribed period of time should be kept moderately low		3. Low risk of exceeding F_{msy}	4. Very low risk of going below an established threshold			5. Maximize yield in the short, medium and long term			6. The risk of steep decline of stock biomass should be kept moderately low	7. Keep inter annual TAC variation below "an established threshold"	
	Perf. stats	$B^{5\text{-}9}_{2044}/B^{5\text{-}9}_{msy}$	$B^{5\text{-}9}_{2044}<B^{5\text{-}9}_{msy}$	$B^{5\text{-}9}_{2030}<0.8B^{5\text{-}9}_{msy}$	$B^{5\text{-}9}_{2044}<0.8B^{5\text{-}9}_{msy}$	$B^{5\text{-}9}_{lowest}/B^{5\text{-}9}_{msy}$	$B^{5\text{-}9}_{2030}<B^{5\text{-}9}_{2025}$	$(F_{2025\text{-}2044}>F_{msy})>0.3$	$B^{sp}_{2044}/B^{sp}_{2025}$	$B^{5\text{-}9}_{2044}/B^{5\text{-}9}_{2025}$	$(B^{5\text{-}9}_{2025\text{-}2044}<0.3B^{5\text{-}9}_{msy})>0.1$	$B^{5\text{-}9}_{lowest}/B^{5\text{-}9}_{msy}<0.3$	avC: 2025-2029	avC: 2025-2034	avC: 2025-2044	$B^{5\text{-}9}_{2030}<0.75B^{5\text{-}9}_{2025}$	AAV: 2025-2029	AAV: 2025-2044
	Criteria	median (80%PI)	Proportion <=0.5	Proportion <=0.25	Proportion <=0.25	median (80%PI)	Proportion <0.25	Count	median (80%PI)	median (80%PI)	Count	Proportion <=0.1	median (80%PI)	median (80%PI)	median (80%PI)	Proportion	median (80%PI)	median (80%PI)
OM1	CMP23_NW	**1.00** (0.61; 1.50)	0.50	0.30	0.25	0.65 (0.47; 0.82)	0.26	4	2.49 (1.34; 4.18)	1.27 (0.73; 2.13)	0	0.02	12.69 (11.59; 13.85)	16.03 (14.11; 18.72)	19.59 (15.19; 26.56)	0.03	0.02 (0.01; 0.04)	0.04 (0.02; 0.06)
	CMP23_3L	**1.00** (0.59; 1.51)	0.50	0.30	0.26	0.65 (0.46; 0.81)	0.26	4	2.54 (1.34; 4.26)	1.29 (0.71; 2.16)	0	0.02	12.60 (11.39; 13.69)	15.84 (13.69; 18.66)	19.38 (14.75; 27.12)	0.03	0.02 (0.01; 0.04)	0.04 (0.02; 0.06)
OM2	CMP23_NW	0.95 (0.46; 1.77)	0.53	0.41	0.34	0.53 (0.32; 0.71)	0.25	5	2.59 (1.39; 4.75)	1.41 (0.64; 2.68)	0	0.08	12.57 (11.55; 13.63)	15.88 (14.03; 18.40)	19.78 (15.04; 27.06)	0.06	0.02 (0.01; 0.04)	0.04 (0.02; 0.07)
	CMP23_3L	1.00 (0.48; 1.86)	0.49	0.31	0.31	0.57 (0.34; 0.75)	0.24	4	2.51 (1.39; 4.36)	1.39 (0.65; 2.65)	0	0.06	12.46 (11.28; 13.41)	15.65 (13.60; 18.22)	19.48 (14.61; 27.11)	0.05	0.02 (0.01; 0.04)	0.04 (0.02; 0.07)
OM3	CMP23_NW	0.99 (0.67; 1.49)	0.51	0.77	0.24	0.34 (0.22; 0.52)	0.75	8	1.82 (0.80; 3.22)	1.29 (0.84; 1.96)	5	0.34	12.66 (11.57; 13.81)	15.43 (13.60; 17.83)	15.21 (12.54; 18.91)	0.28	0.02 (0.01; 0.04)	0.02 (0.01; 0.03)
	CMP23_3L	1.01 (0.69; 1.52)	0.48	0.77	0.21	0.35 (0.22; 0.53)	0.75	8	1.94 (0.87; 3.36)	1.31 (0.86; 2.00)	5	0.33	12.58 (11.38; 13.66)	15.34 (13.25; 17.77)	14.73 (11.99; 18.72)	0.28	0.02 (0.01; 0.04)	0.03 (0.02; 0.04)
OM4	CMP23_NW	0.95 (0.55; 1.43)	0.58	0.35	0.30	0.61 (0.43; 0.78)	0.26	7	2.28 (1.15; 3.86)	1.25 (0.70; 2.14)	0	0.02	12.59 (11.50; 13.76)	15.75 (13.85; 18.38)	18.60 (14.38; 25.23)	0.03	0.02 (0.01; 0.04)	0.03 (0.02; 0.06)
	CMP23_3L	0.95 (0.55; 1.46)	0.56	0.35	0.31	0.61 (0.42; 0.77)	0.26	5	2.38 (1.19; 4.13)	1.26 (0.69; 2.18)	0	0.03	12.43 (11.25; 13.56)	15.44 (13.33; 18.25)	18.10 (13.86; 25.37)	0.03	0.02 (0.01; 0.04)	0.03 (0.02; 0.06)
OM5	CMP23_NW	0.96 (0.53; 1.50)	0.54	0.30	0.30	0.63 (0.42; 0.81)	0.29	6	2.29 (1.19; 3.85)	1.20 (0.62; 2.08)	0	0.03	12.61 (11.52; 13.77)	15.78 (13.91; 18.39)	18.57 (14.50; 25.02)	0.06	0.02 (0.01; 0.04)	0.03 (0.02; 0.06)
	CMP23_3L	0.99 (0.52; 1.54)	0.52	0.30	0.30	0.63 (0.42; 0.81)	0.28	5	2.40 (1.22; 4.03)	1.24 (0.62; 2.13)	0	0.03	12.46 (11.29; 13.55)	15.49 (13.39; 18.26)	18.12 (13.93; 25.12)	0.06	0.02 (0.01; 0.04)	0.03 (0.02; 0.06)
OM6	CMP23_NW	0.96 (0.55; 1.45)	0.55	0.34	0.30	0.63 (0.46; 0.80)	0.30	5	2.43 (1.29; 4.08)	1.20 (0.66; 2.03)	0	0.02	12.88 (11.75; 14.05)	16.48 (14.48; 19.24)	20.71 (16.00; 27.98)	0.05	0.02 (0.01; 0.04)	0.04 (0.02; 0.06)
	CMP23_3L	1.00 (0.59; 1.52)	0.49	0.29	0.25	0.65 (0.46; 0.81)	0.26	4	2.53 (1.38; 4.15)	1.29 (0.72; 2.15)	0	0.02	12.59 (11.38; 13.65)	15.84 (13.69; 18.60)	19.42 (14.88; 26.63)	0.03	0.02 (0.01; 0.04)	0.04 (0.02; 0.06)

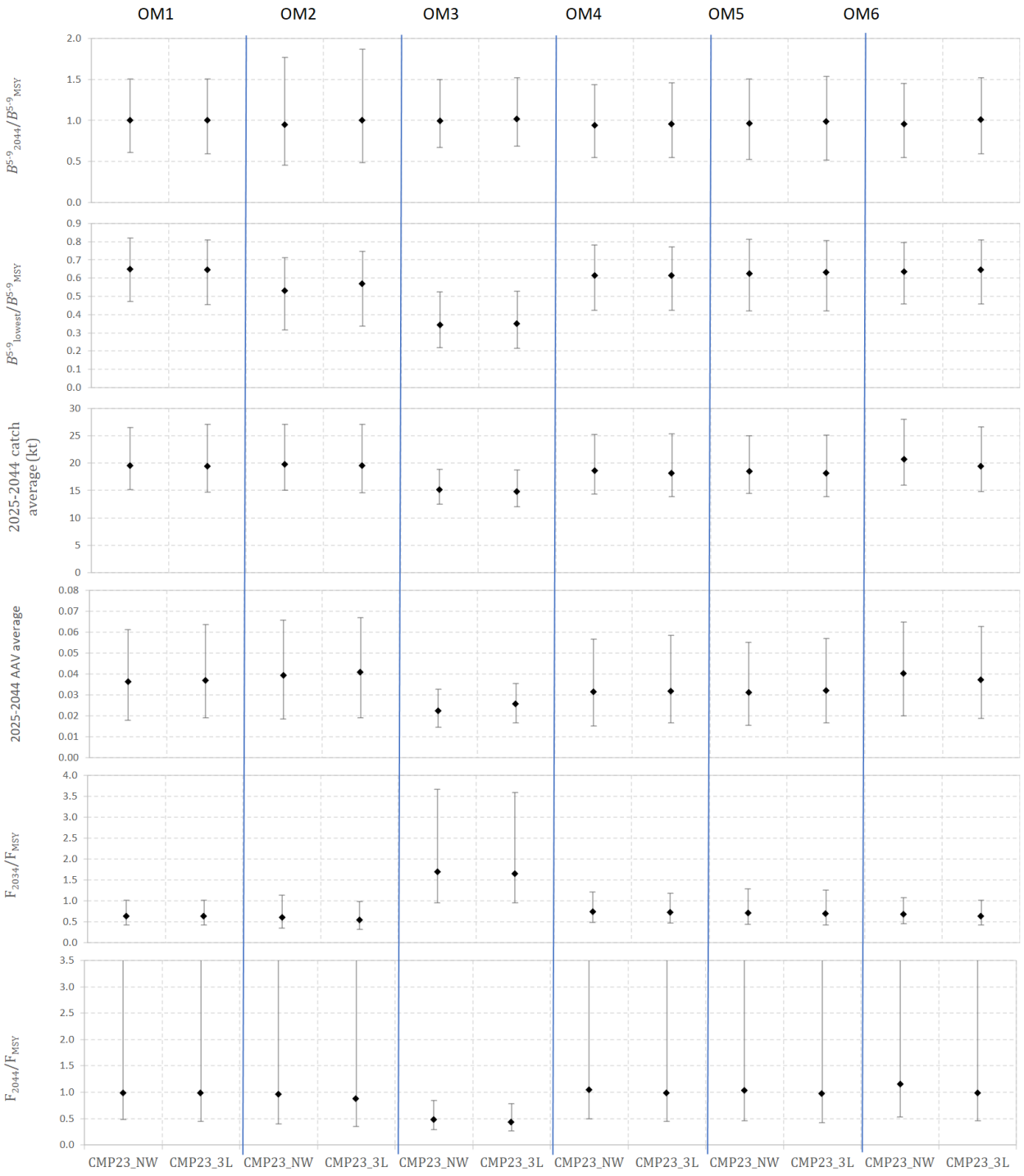

Figure Add1: Projected median and 80% PIs for a series of performance statistics for each OM under CMP23_NW and CMP23_3L.

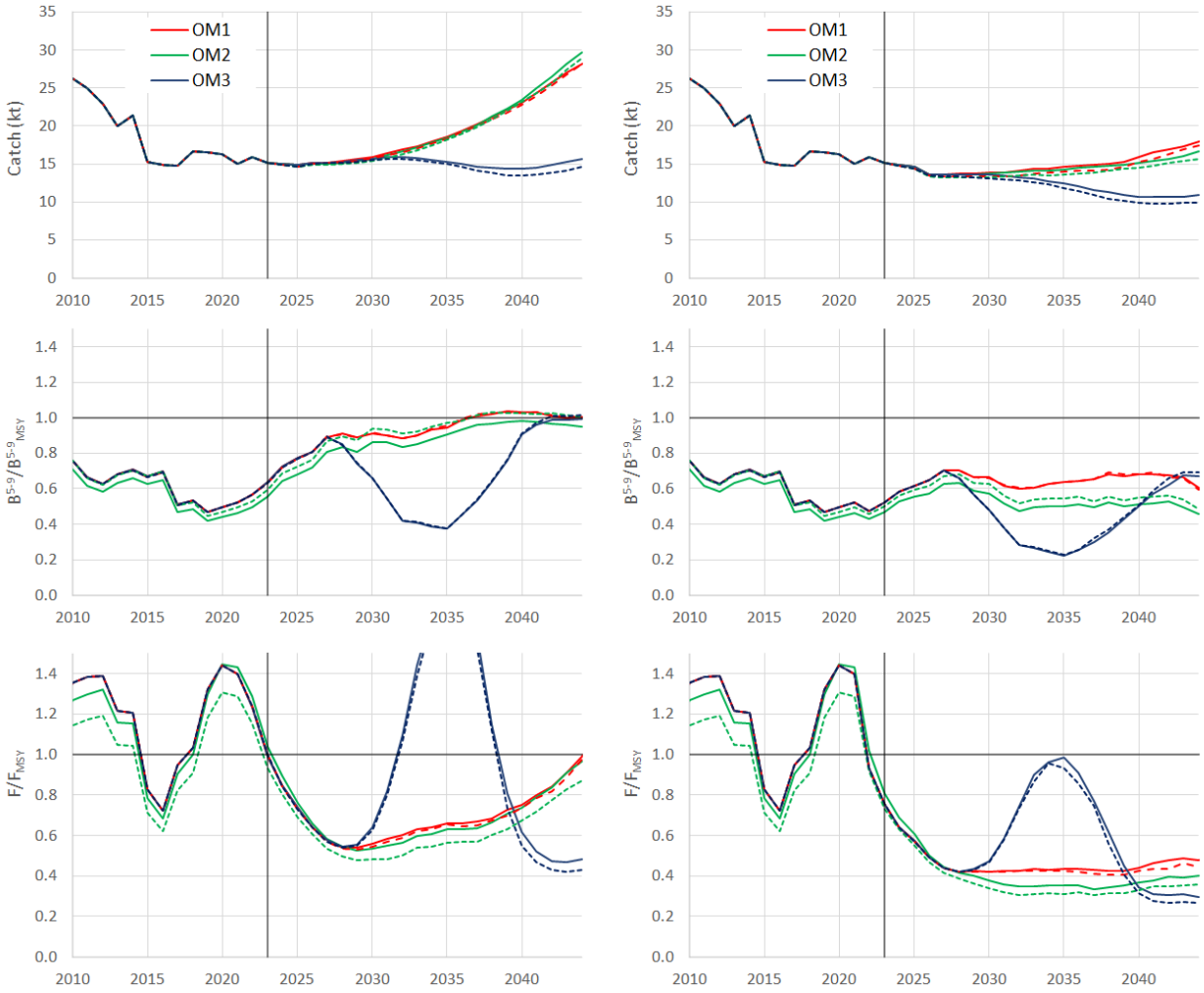

Figure Add2a: Projected median and lower 10%iles for catch, spawning and exploitable biomass (both relative to B_{MSY}) and F/F_{MSY} (the upper 10%iles are plotted instead of lower 10%iles) for **OM1**, **OM2** and **OM3** under **CMP23_NW (full lines)** and **CMP23_3L (dashed lines)**.

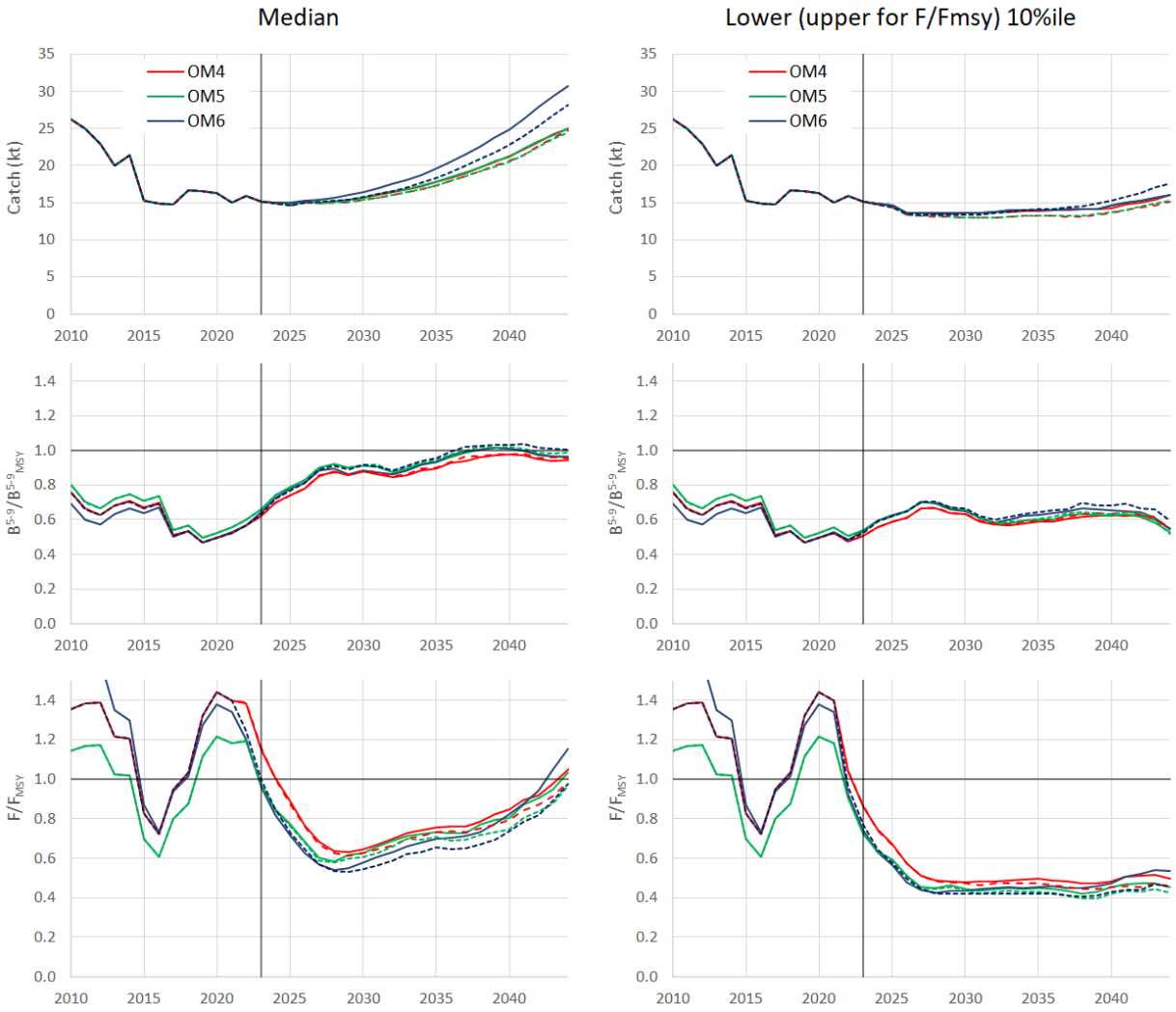

Figure Add2b: Projected median and lower 10%iles for catch, spawning and exploitable biomass (both relative to B_{MSY}) and F/F_{MSY} (the upper 10%iles are plotted instead of lower 10%iles) for **OM4**, **OM5** and **OM6** under **CMP23_NW (full lines)** and **CMP23_3L (dashed lines)**.