



NOAA
FISHERIES

Assessment of Shallow-water flatfish stock complex in the Gulf of Alaska

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Harvest recommendations

Quantity	As estimated or specified last year for:		As estimated or recommended this year for:	
	2021	2022	2022+	2023+
M (natural mortality rate; female, male)	0.2, 0.253*		See area specific estimates	
Tier	3a		3a	3a
Projected total (age 0+) biomass (t)	94,612	94,614	98,387	100,919
Projected Female spawning biomass (t)	47,694	46,330	35,474	39,682
$B_{100\%}$	51,387	51,387	See area specific estimates	
$B_{40\%}$	20,555	20,555		
$B_{35\%}$	17,985	17,985		
F_{OFL}	0.462	0.462		
$\max F_{ABC}$	0.382	0.382		
F_{ABC}	0.382	0.382		
OFL (t)	21,080	21,191	14,027	14,810
$\max ABC$ (t)	17,756	17,851	11,882	12,551
ABC (t)	17,756	17,851	11,882	12,551
Status	As determined last year for:		As determined this year for:	
	2019	2020	2020	2021
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

Harvest recommendations

Northern rock sole: Central Gulf Quantity	As estimated or <i>specified last year for:</i>		As estimated or <i>recommended this year for:</i>	
	2021	2022	2022	2023
<i>M</i> (natural mortality rate; female, male)			0.2, 0.232	0.2, 0.232
Tier			3a	3a
Projected total (age 0+) biomass (t)			35,089	36,945
Projected Female spawning biomass (t)			11,694	13,861
<i>B</i> _{100%}		This was not done in 2017-2020	21,622	21,622
<i>B</i> _{40%}			8,649	8,649
<i>B</i> _{35%}			7,568	7,568
<i>F</i> _{OFL}			0.187	0.187
<i>maxF</i> _{ABC}			0.157	0.157
<i>F</i> _{ABC}			0.157	0.157
OFL (t)			4,691	5,075
maxABC (t)			3,999	4,329
ABC (t)			3,999	4,329
	As determined <i>last year</i> for:		As determined <i>this year</i> for:	
Status	2019	2020	2020	2021
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

Harvest recommendations

Northern rock sole: Western Gulf Quantity	As estimated or <i>specified last year for:</i>		As estimated or <i>recommended this year for:</i>	
	2021	2022	2022	2023
<i>M</i> (natural mortality rate; female, male)			0.2, 0.254	0.2, 0.254
Tier			3a	3a
Projected total (age 0+) biomass (t)			63,298	63,974
Projected Female spawning biomass (t)			23,780	25,821
$B_{100\%}$		This was not done in 2017-2020	28,656	28,656
$B_{40\%}$			11,462	11,462
$B_{35\%}$			10,030	10,030
F_{OFL}			0.270	0.270
$maxF_{ABC}$			0.225	0.225
F_{ABC}			0.225	0.225
OFL (t)			9,336	9,735
maxABC (t)		7,883	8,222	
ABC (t)		7,883	8,222	
Status	As determined <i>last year for:</i>		As determined <i>this year for:</i>	
	2019	2020	2020	2021
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

Harvest recommendations

Quantity	As estimated or <i>specified last year for:</i>		As estimated or <i>recommended this year for:</i>	
	2021	2022	2022	2023
<i>M</i> (natural mortality rate; female, male)	0.2, 0.248*	0.2, 0.248*	See area specific rates	
Tier	3a	3a	3a	3a
Projected total (age 0+) biomass (t)	144,833	148,917	163,737	173,631
Projected Female spawning biomass (t)	72,973	73,930	73,114	83,900
$B_{100\%}$	93,518	93,518	See area specific estimates	
$B_{40\%}$	37,407	37,407		
$B_{35\%}$	32,731	32,731		
F_{OFL}	0.326	0.326		
$maxF_{ABC}$	0.271	0.271		
F_{ABC}	0.271	0.271		
OFL (t)	27,204	27,943	30,288	32,514
maxABC (t)	22,990	23,614	25,555	27,441
ABC (t)	22,990	23,614	25,555	27,441
Status	As determined <i>last</i> year for:		As determined <i>this</i> year for:	
	2019	2020	2020	2021
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

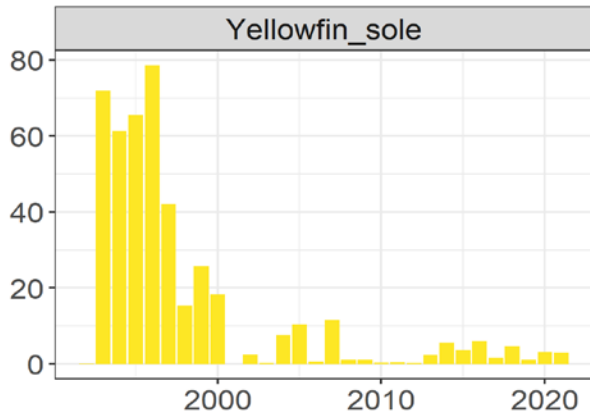
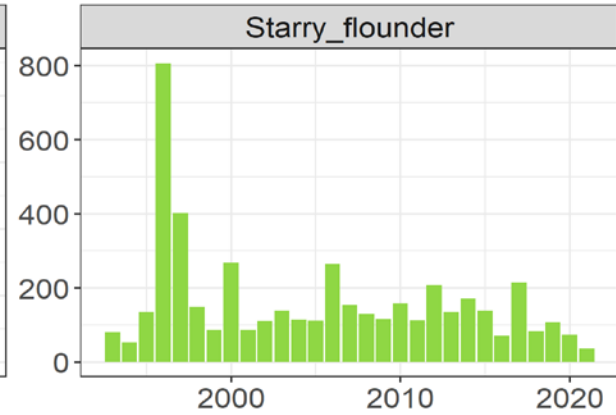
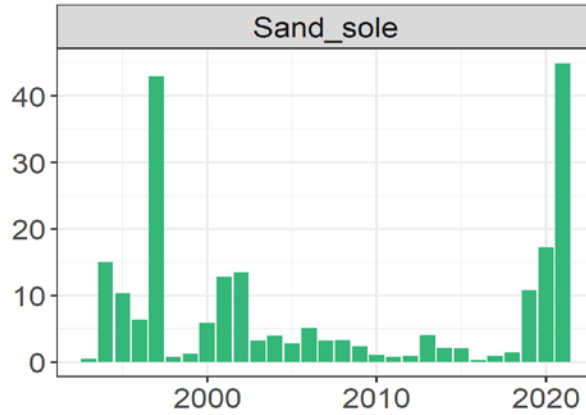
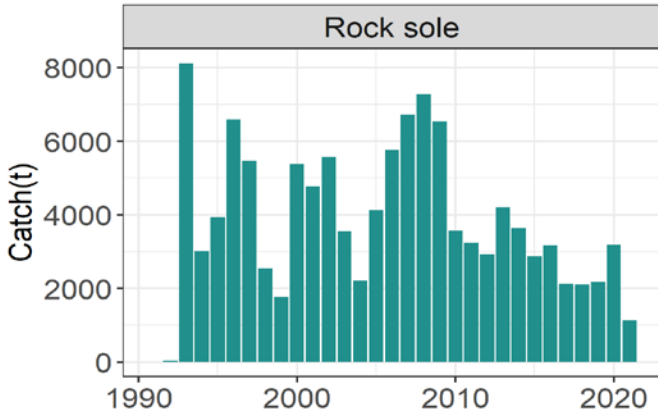
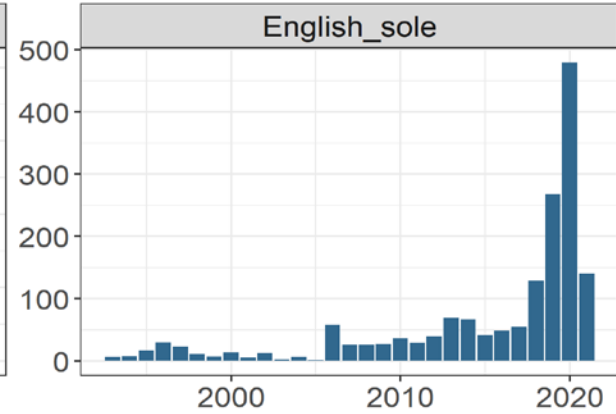
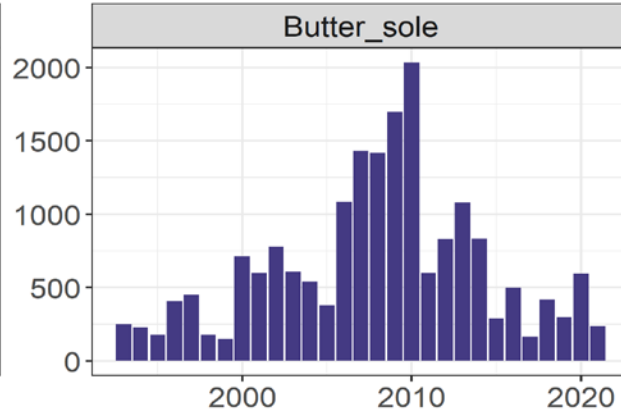
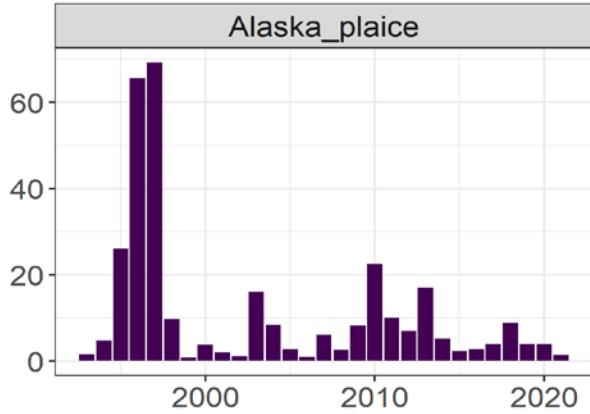
Harvest recommendations

Southern rock sole Central Gulf Quantity	As estimated or <i>specified last year for:</i>		As estimated or <i>recommended this year</i> for:	
	2021	2022	2022	2023
<i>M</i> (natural mortality rate; female, male)			0.2, 0.253	0.2, 0.253
Tier			3a	3a
Projected total (age 0+) biomass (t)			88,391	94,107
Projected Female spawning biomass (t)			37,555	43,470
$B_{100\%}$		This was not done in 2017-2020	54,439	54,439
$B_{40\%}$			21,376	21,376
$B_{35\%}$			18,703	18,703
F_{OFL}			0.268	0.268
$maxF_{ABC}$			0.224	0.224
F_{ABC}			0.224	0.224
OFL (t)			15,622	16,853
maxABC (t)		13,185	14,229	
ABC (t)		13,185	14,229	
Status	As determined <i>last year for:</i>		As determined <i>this year</i> for:	
	2019	2020	2020	2021
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

Harvest recommendations

Southern rock sole Western Gulf	As estimated or <i>specified last year for:</i>		As estimated or <i>recommended this year</i> for:	
	2021	2022	2022	2023
<i>M</i> (natural mortality rate; female, male)			0.2, 0.271	0.2, 0.271
Tier			3a	3a
Projected total (age 0+) biomass (t)			75,346	79,524
Projected Female spawning biomass (t)			35,559	40,430
$B_{100\%}$			43,788	43,788
$B_{40\%}$			17,515	17,515
$B_{35\%}$			15,326	15,326
F_{OFL}			0.335	0.335
$maxF_{ABC}$			0.278	0.278
F_{ABC}			0.278	0.278
OFL (t)			14,666	15,661
maxABC (t)			12,370	13,212
ABC (t)			12,370	13,212
	As determined <i>last year for:</i>		As determined <i>this year</i> for:	
Status	2019	2020	2020	2021
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

GOA SWF catch



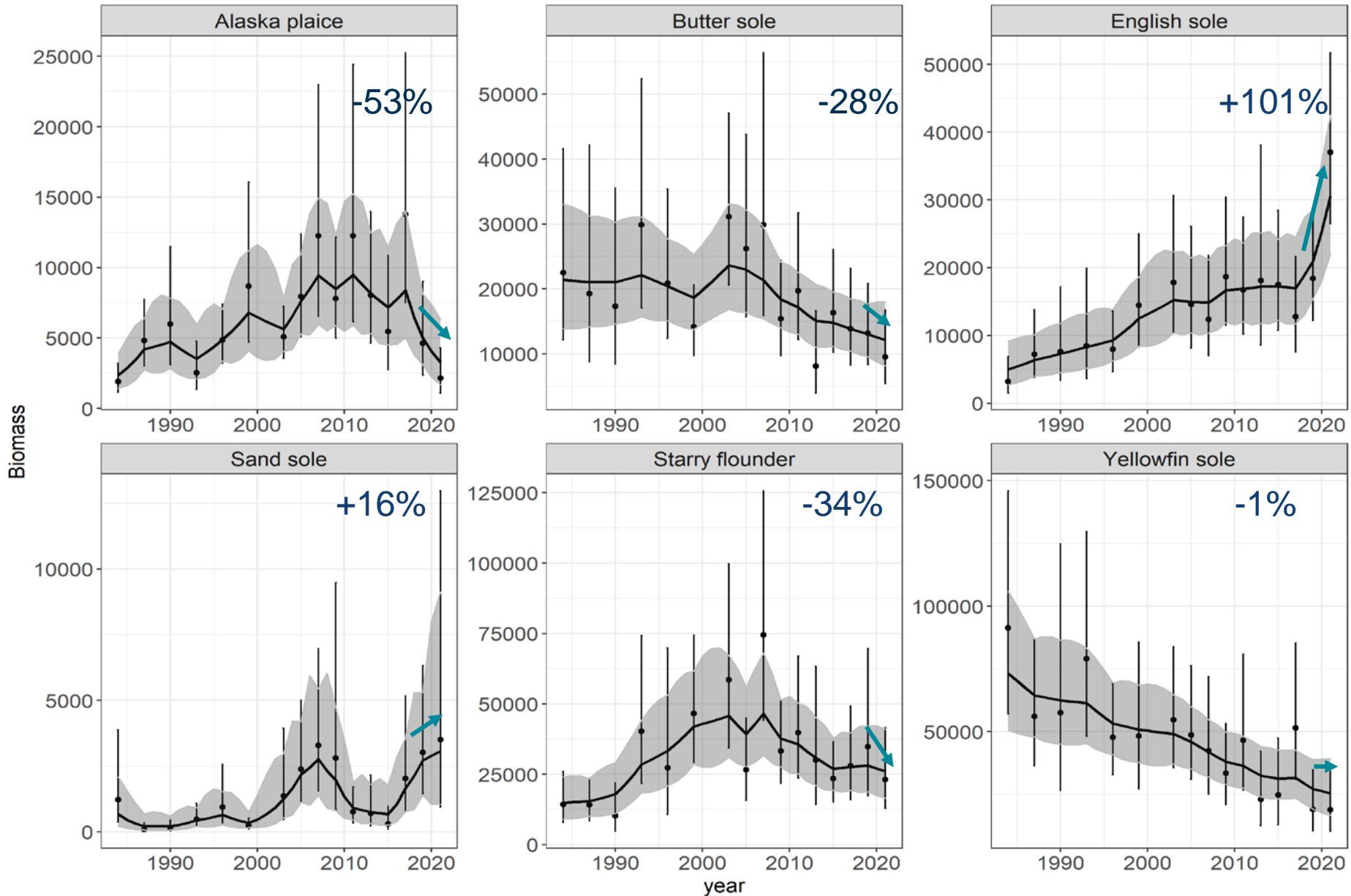
Year

GOA SWF tier-5 biomass

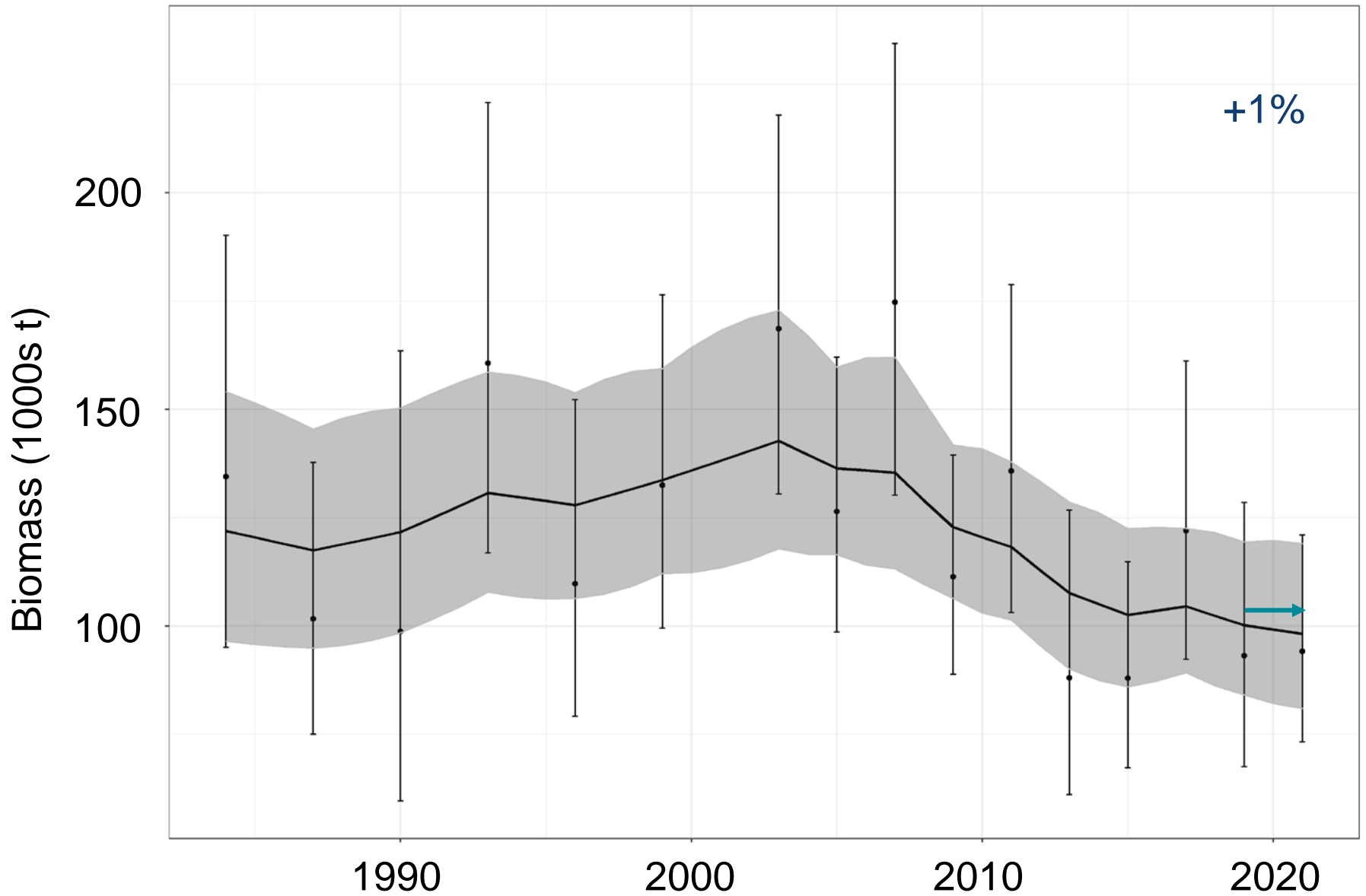
- Species-specific biomass estimated by random effects (RE) model
 - 1984-2021 GOA bottom trawl survey biomass
 - 2011 excluded because eastern GOA was not surveyed
 - Species-specific proportions derived
- Total tier-5 biomass estimated by RE model
- Species-specific biomass adjusted to match total tier-5 biomass estimated from RE model
 - $B_{adj,s,t} = proportion_{s,t} Total_t$
 - $OFL_{s,2022} = B_{adj,s,2021} F_{OFL}$
 - $ABC_{s,2022} = B_{adj,s,2021} 0.75 F_{OFL}$
 - $F_{OFL} = 0.2$



GOA SWF survey biomass



GOA SWF total tier-5 biomass



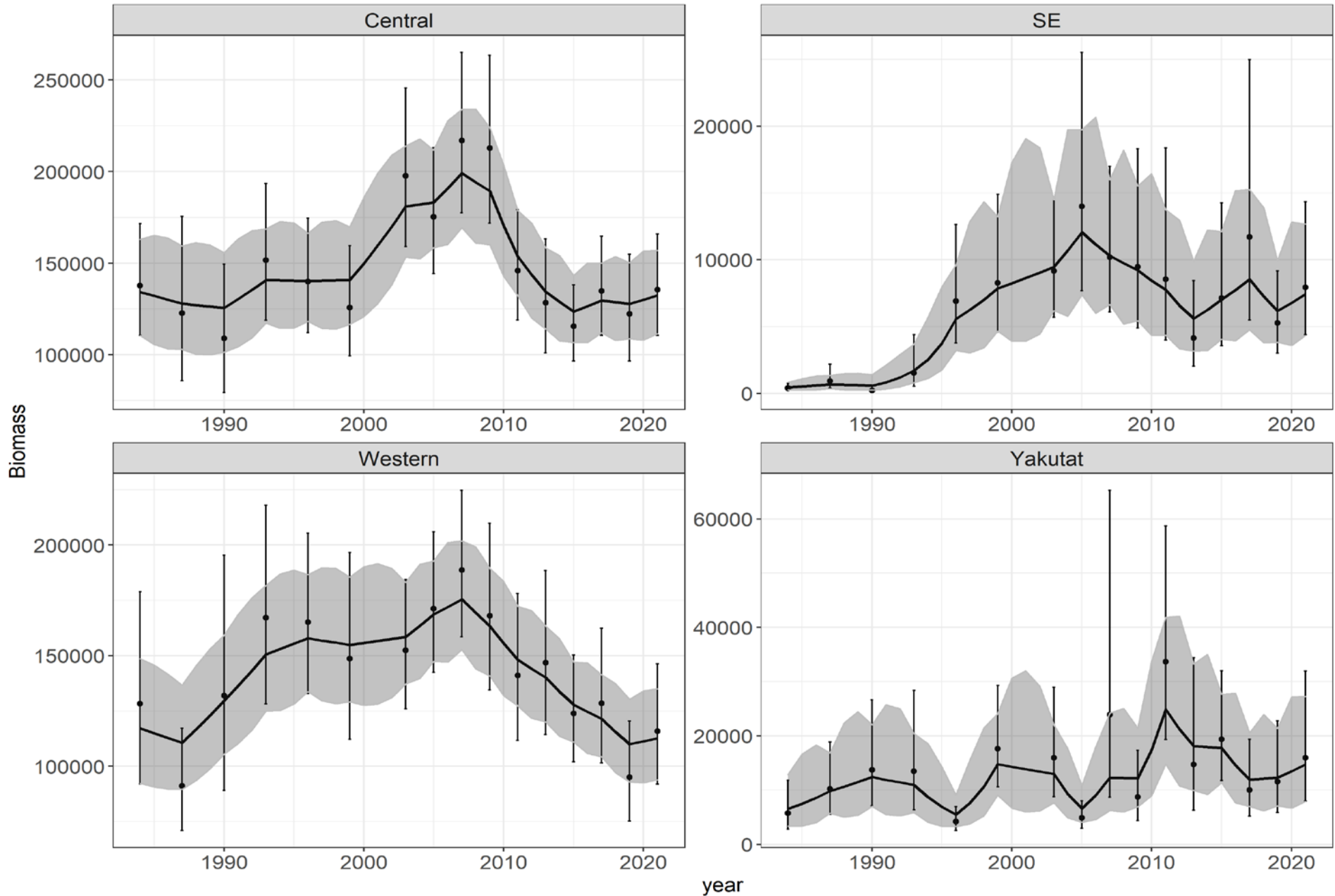
Harvest recommendations

Species	Tier	FABC	FOFL	2021 Biomass	2022 Biomass	As specified last year for:				As recommended this year for:			
						2021		2022		2022		2023	
						ABC	OFL	ABC	OFL	ABC	OFL	ABC	OFL
Shallow-water flatfish													
Northern rock sole	3a	*	*	94,612	98,387	17,756	21,080	17,851	21,191	11,882	14,027	12,551	14,810
Southern rock sole	3a	*	*	144,833	163,737	22,990	27,204	23,614	27,943	25,555	30,228	27,441	32,514
Yellowfin sole	5	0.15	0.2	31,259	24,835	4,689	6,252	4,689	6,252	3,725	4,967	3,725	4,967
Butter sole	5	0.15	0.2	14,304	11,873	2,146	2,861	2,146	2,861	1,781	2,375	1,781	2,375
Starry flounder	5	0.15	0.2	30,605	25,433	4,591	6,121	4,591	6,121	3,814	5,086	3,814	5,086
English sole	5	0.15	0.2	16,943	29,867	2,541	3,389	2,541	3,389	4,480	5,973	4,480	5,973
Sand sole	5	0.15	0.2	2,673	3,000	401	535	401	535	450	600	450	600
Alaska plaice	5	0.15	0.2	6,997	3,196	1,050	1,399	1,050	1,399	479	639	479	639
Total				342,226	360,328	56,164	68,841	56,883	69,691	52,166	63,895	54,721	66,964

Apportionment

- Area-specific biomass estimated by RE model
 - Tier-5 + northern and southern rock sole survey biomass
 - Western, Central, Yakutat, SE

GOA survey biomass by area



Apportionment

- Area-specific biomass estimated by RE model
 - Tier-5 + northern and southern rock sole survey biomass
 - Western, Central, Yakutat, SE

	Western	Central	Yakutat	Southeast
Random effects model 2021 assessment percentage	42.18	49.5	5.5	2.8
Random effects Model 2021 Biomass estimates	112,716	132,366	14,704	7,426

Apportionment

- Area-specific biomass estimated by RE model
 - Tier-5 + northern and southern rock sole survey biomass
 - Western, Central, Yakutat, SE

	Western	Central	Yakutat	Southeast
Proportions this assessment	42%	50%	5%	3%
2022 ABC	21,910	26,083	2,608	1,565
2023 ABC	22,983	27,360	2,736	1,642



Risk table – Assessment considerations

Assessment-related considerations	Population dynamics considerations	Environmental/ecosystem considerations	Fishery Performance considerations
Level 2	Level 1	Level 1	Level 1

- GOA northern rock sole assessment
 - Exhibits a strong retrospective pattern
 - Indications of non-stationarity in fit to survey biomass
- We propose a level 2 designation for this category



Risk table – Population dynamics considerations

Assessment-related considerations	Population dynamics considerations	Environmental/ecosystem considerations	Fishery Performance considerations
Level 2	Level 1	Level 1	Level 1

- The population trajectories of northern and southern rock sole have been relatively stable or showing signs of increasing biomass
- Yellowfin sole has shown a consistent decline since 1996
- Given the light exploitation of this complex, we propose a level 1 designation for this category



Risk table – Ecosystem considerations

Assessment-related considerations	Population dynamics considerations	Environmental/ecosystem considerations	Fishery Performance considerations
Level 2	Level 1	Level 1	Level 1

- “We score this category level 1 designation for shallow water flatfish given moderate thermal conditions for adults and moderate to below average thermal conditions for larvae, mixed/unknown trends in abundance of prey, predators, and competitors, and a lack of a mechanistic understanding for the direct and indirect effects of environmental change on the survival and productivity of most shallow water flatfish. A trend to watch is the declining catch of GOA yellowfin sole, and whether there is a relationship to warming temperatures (e.g., distribution shift or physiological effects).”



Risk table – Fishery performance considerations

Assessment-related considerations	Population dynamics considerations	Environmental/ecosystem considerations	Fishery Performance considerations
Level 2	Level 1	Level 1	Level 1

- Fishery has consistently only captured a small fraction of the ABC (~9% on average since 2007)
- Primarily caught in the central GOA
- Overlapping species distributions weaker stocks could be at risk under higher exploitation
- Given the light exploitation of this stock we propose level 1 designation for this category



Risk table – Fishery performance considerations

Assessment-related considerations	Population dynamics considerations	Environmental/ecosystem considerations	Fishery Performance considerations
Level 2	Level 1	Level 1	Level 1

- Lightly exploited complex
- Obtains small percentage of annual TAC and maximum ABC
- We propose level 1 designation for this category

- Not recommending a reduction in maximum ABC

