Longline Pot Gear for Bering Sea Greenland Turbot

Discussion Paper

February 2022[1]

1 Introduction 1
2 Background 2
2.1 Existing non-trawl groundfish gear and season regulations for the BSAI 2
2.2 Greenland turbot fishery participation and harvest 3
2.3 Killer whale depredation on BSAI hook-and-line gear 8
3 Additional Issues for Consideration 11
3.1 Potential effect on participation and associated issues 11
3.2 Bycatch 13
3.3 Marine mammals 18
3.4 Observer Program and monitoring 20
4 Summary of Issues 21
5 References 24
6 Contributors and Persons Consulted 25

1 Introduction

In April 2021, the North Pacific Fishery Management Council (Council) tasked staff to prepare a discussion paper considering the authorization of longline pot gear as legal gear for Greenland turbot (*Reinhardtius hippoglossoides*) in the Bering Sea (BS) management area.[2] The Council's motion was responsive to the Advisory Panel's recommendation that longline pot gear could be an effective mitigation measure to address killer whale depredation of Greenland turbot on hook-and-line (HAL) gear. Greenland turbot are currently fished in the BS and the Aleutian Islands (AI) with HAL gear and trawl gear. HAL fishing is presently conducted by members of the Freezer Longline Conservation Cooperative (FLCC), which is a voluntary cooperative made up of HAL catcher/processors (CPs) that primarily target Pacific cod. The HAL CP segment of the Greenland turbot fishery is the primary focus of this discussion paper and would account for most of the directly impacted stakeholders if the Council develops an amendment to gear regulations. This paper also considers vessels that use pot gear to fish other BS groundfish species but are not part of the FLCC. Trawl fishing for Greenland turbot is conducted by the BSAI non-pollock trawl CP fleet, commonly referred to as the Amendment 80 sector (A80).

If the Council were to develop an analytical package and recommend a change in legal gear types, Federal regulations would be amended at §679.24 Gear Limitations. No amendment to the Council's BSAI Groundfish Fishery Management Plan (FMP) would be required. Gear authorization is addressed in Section 3.4 of the FMP; for non-trawl gear the FMP simply refers to Federal regulations.

Section 2 describes existing gear regulations for non-trawl vessels catching groundfish in the BS and AI, Greenland turbot fishery participation and harvest data, and characterizes the state of killer whale depredation to the extent possible given available fishery and longline survey data. (This paper uses "fixed-gear" as a general reference to non-trawl fishing with HAL or pot gear; Federal regulations have a definition of fixed gear that is specific to sablefish and halibut, which is not how the term is used here.) Catcher vessels (CV) are not excluded from the Greenland turbot fishery, nor would they be under any

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[2] Council Motion, April 16, 2021.

action related to this paper. However, fishery data analyzed back to 2003 (the implementation of the NMFS Catch Accounting system) show that no CVs of any gear type – HAL, pot, or trawl – are targeting Greenland turbot in the BSAI.

Section 3 identifies issues that the Council might consider if it chooses to initiate an analysis. This section provides context on the following topics: whether a new gear authorization could result in additional vessels targeting Greenland turbot with fixed-gear; whether additional vessels might affect the voluntary harvest sharing agreement between the FLCC and A80; the extent to which additional pot gear effort might result in additional bycatch of certain species or interactions with marine mammals; and potential effects on the Observer Program.

Section 4 provides a summary with reference to the overarching question before the Council: whether authorizing longline pot gear in the BS Greenland turbot fishery will provide a net benefit to the nation. That question could be answered by weighing potential fishery performance – in the context of whale depredation – against how the introduction of longline pot gear might affect fishery participation and the net change in impacts on non-target species, including prohibited species and marine mammals.

2 Background

2.1 Existing non-trawl groundfish gear and season regulations for the BSAI

Federal Regulations at '§679.24(b) Gear Limitations (1) Pots' state that any person using longline pot gear must treat any catch of groundfish as prohibited species, with four exceptions (*paraphrased*): (i) fishing in the AI subarea; (ii) directed fishing for sablefish in the BS subarea; (iii) directed fishing for IFQ sablefish in the GOA; (iv) fishing for IFQ or CDQ halibut in the BSAI. A regulatory amendment resulting from a Council action on this issue would likely add a fifth exception for vessels directed fishing for Greenland turbot in the BS.

Currently, any vessel with a Federal Fisheries Permit (FFP) for groundfish and the necessary gear (non-trawl) and area (BS) endorsement on its License Limitation Program (LLP) license may fish *single* pots for Greenland turbot in the BS. The FFP must have a pot gear endorsement as well; that endorsement is free to obtain. Pacific cod is an "improved retention / improved utilization" (IR/IU)) species, as defined in regulation at §679.27. Any Pacific cod caught in single pot gear by an FFP vessel while targeting Greenland turbot must be retained if Pacific cod directed fishing is open for the vessel. If Pacific cod directed fishing is closed for a vessel then cod must be retained up to the maximum retainable amount (MRA). A vessel that is not named on an LLP license with a CP Pacific cod pot gear endorsement may not retain more than the MRA of Pacific cod. Any Pacific cod caught on a haul that is assigned a Greenland turbot "target" by a vessel without a Pacific cod endorsement would accrue to the BSAI HAL/Pot Pacific cod incidental catch allowance (ICA). If a vessel has a Pacific cod pot endorsement and the haul is assigned a Pacific cod "target" based on catch then the cod accrues to the BSAI Pot CP sector.

Fishery participants who are familiar with the BS Greenland turbot fixed-gear fishery conveyed to the analysts that single pots have not been deployed because of their inefficiency in the particular depth and location where the fishery occurs. Hauling single pots from great depths and substantial drag from currents would be a slow process that was said to be uneconomical.

There is currently no limit on the number of pots a vessel can deploy while fishing in BS groundfish fisheries for which pot gear is currently authorized – e.g., Pacific cod or sablefish IFQ. The motion initiating this paper does not propose a pot limit and thus one is not considered at this time. Given the "longline pot" nature of this proposal, the number of pots deployed should not affect the likelihood of impacts on marine mammals if the total number of sets does not increase (see Section 3.3). Furthermore, NMFS – in consultation with NOAA Office of Law Enforcement and the Council – recently determined that a "pot tag" requirement is not an efficient or effective way to enforce a pot limit in the GOA sablefish

IFQ fishery and removed the pot tag requirement in December 2021.[3] In light of that rulemaking, the analysts do not anticipate that a pot tag requirement would be part of any new gear authorization for the BS Greenland turbot fishery.

Directed fishing for Greenland turbot in the BS and AI is authorized from May 1 through December 31 (§679.23(e)(1)). Greenland turbot is open for vessels fishing Community Development Quota (CDQ) on January 1 (see Section 2.2.1 of this paper). According to the Stock Assessment and Fishery Evaluation (SAFE) report, the HAL fleet "generally targets pre-spawning aggregations of Greenland turbot [from] June to August in the BS to avoid killer whale predation" (Bryan et al. 2020, p.5). In addition to the reported preference for targeting Greenland turbot between May and August, the later opening of the fishery dates back to the period before the BSAI HAL CP Pacific cod fishery was managed with a voluntary cooperative – the FLCC. Prior to cooperative management, the HAL CP sector was engaged in a race for Pacific cod during the first several months of the fishing year due to its relatively higher value and greater volume of available catch.

2.2 Greenland turbot fishery participation and harvest

The first subsection below characterizes the non-trawl and trawl gear CP sectors that target Greenland turbot relative to each other. The following subsections are focused on the non-trawl sector, given the focus of any potential action on the HAL and pot sectors. As noted in the introduction, CVs have not targeted Greenland turbot during the analyzed period; this is likely due to the remoteness of the area where directed fishing occurs and characteristics of Greenland turbot flesh that would degrade value in the time required to make a shoreside landing.

This section is primarily focused on the BS area since that is the focus of the considered action. Individuals familiar with the BSAI fixed-gear fishery noted to staff that – while longline pot gear is currently authorized in the AI – a significant Greenland turbot fishery has not developed in the AI for two primary reasons: low TAC due to lower local abundance, and less value due to poorer fish quality and higher operating costs. As an example of relative area availability, the 2021 initial TAC for Greenland turbot was 4,904 mt in the BS and 765 mt in the AI (BS is inclusive of CDQ allocations).[4] The Council's recommended TACs for 2022 increased by 8% in the BS and 14% in the AI, but the BS TAC is still more than five-times the volume in the AI. Individuals familiar with BSAI fixed-gear also noted that fishing pot gear at the depths necessary to target Greenland turbot would be more challenging in the AI due to strong currents relative to the BS. Directed fishing for Greenland turbot in the AI was closed in 2021 because the TAC did not support directed fishing.

2.2.1 Fixed-Gear; Trawl; CDQ

This section focuses mainly on data from 2010 to present, which best reflects the current, cooperatively managed states of the two most relevant sectors: the FLCC (HAL CPs) and Amendment 80 (non-pollock trawl CPs). Historical data on Greenland turbot catch by gear sector dating back to 1977 is available in the SAFE report (see Table 5.1 in Bryan et al. 2020, p.27). That table is not reproduced here; it shows the changing nature of the Greenland turbot fishery in terms of biomass, catch limits, and participation by gear sector. As noted in the previous section, the Greenland turbot stock was at much higher levels in the 1970s and 1980s. The ABC peaked at 90,000 mt in 1979 and was only below 20,000 mt once (1988) prior to 1990 when the ABC fell from 20,300 mt to 7,000 mt. Total catch (including discards) was never less than 23,000 mt from 1977 to 1984. Until the early 1990s, total catch was dominated by the trawl sector. Then, from 1992 through 2007 the fixed-gear sector caught more Greenland turbot in every year except one. The trawl sector's catch rebounded around the time that A80 cooperatives were implemented in

[3] 86 FR 70751. Published December 13, 2021.
[4] Initial TAC, or ITAC, is the remainder after 15% of certain species' TAC is apportioned to the "non-specified reserve" that NMFS uses for inseason management.

2008. Catch by the FLCC and A80 sectors was roughly equivalent – to within 100 to 500 mt – from 2010 through 2016. Catch by fixed-gear CPs has been substantially lower since 2017. Table 2-1 is a snapshot of Greenland turbot TAC and catch in 2021, showing the current low state of TAC utilization overall and by the fixed-gear sector in particular. BS non-CDQ catch is further described in Table 2-2.

Table 2-1 2021 BSAI Greenland turbot catch (through 12/11/2021)

	ITAC (mt)	HAL (mt)	Trawl (mt)	Total Catch (mt)	Total Catch as % TAC
Bering Sea Non-CDQ	4,356	11	1,116	1,128	26%
Bering Sea CDQ	548	0	2	2	0%
Aleutian Islands*	765	1	465	467	61%

* Directed fishing was closed in Aleutian Islands: Source: NMFS Information Bulletin 21-23, April 22, 2021.

The recent catch trends by sector are occurring in the context of a voluntary TAC-split agreement between FLCC and the A80 sector. In 2012 the Council reviewed a discussion paper that responded to a proposal to allocate Greenland turbot TAC between the trawl and non-trawl sectors (NPFMC 2012). The Council heard testimony that competition between sectors may have been responsible for early directed fishing closures. Ultimately, the Council chose not to develop allocations and instead encouraged the two sectors to reach a non-regulatory agreement for the BS area, which they did. That agreement has been in place since 2013.[5] The terms of the agreement are not public and are not known to the analysts. The agreement is specifically between the FLCC and the A80 cooperative, and includes a set-aside for incidental catch in other fisheries. Those two groups do not encompass all vessels that *could* target Greenland turbot but, to date, they do encompass all the vessels that *are* targeting the species.

The fixed-gear, trawl, and CDQ sectors are briefly described below. Relevant data are provided in the next subsection.

Fixed-Gear

The BS and AI fixed-gear sector that targets Greenland turbot comprises HAL CPs that are all members of the FLCC.[6] FLCC vessels primarily harvest Pacific cod but some members also rely on Greenland turbot and/or sablefish as secondary sources of the revenue they generate in the BSAI. The FLCC is made up of 36 LLP licenses that are endorsed for BS or AI HAL CP fishing for Pacific cod. Of note, three of those LLPs are also endorsed for Pacific cod pot fishing in the BS area – accounting for three of the eight total BSAI Pacific cod pot CP LLPs.

Since the formation of the FLCC in 2010 the sector has operated what could be considered a "year-round" Pacific cod fishery as compared to any other Federal fishery off Alaska. The Pacific cod target fishery provides the best count of total annual FLCC vessel participation (activity in the Greenland turbot fishery, in particular, is described in the next subsection). The HAL CP vessel count in the Pacific cod target peaked at 36 in 2010. The number of FLCC vessels has been in the low-20s in recent years but only 17 fished in 2021. Between 11 and 15 of these vessels have fished CDQ Pacific cod in recent years, though only a small number have fished CDQ Greenland turbot (see Table 2-4). Total gross revenues for FLCC

[5] See summary on page 4 of the June 2012 Council Newsletter: www.npfmc.org/wp-content/PDFdocuments/newsletters/NEWS612.pdf.

[6] The U.S. Congress defined the "Longline Catcher Processor Subsector" as the holders of an LLP license that is endorsed for BS or AI fishing as a CP that can target Pacific cod with HAL gear in a 2010 bill titled the Longline Catcher Processor Subsector Single Fishery Cooperative Act. This legislation was never implemented because the sector participants reached a private, voluntary agreement to form a cooperative (FLCC). Nevertheless, the fact that the sector has been defined in statute twice – also including a definition in the 2005 Department of Commerce and Related Agencies Appropriations Act (Section 219(a)(6) of Public Law 108-447; 118 Stat. 2886) – may be of interest if the Council considers whether a longline pot fishery should be open to all holders of a pot-endorsed LLP license or only to members of a certain "subsector".

vessels have ranged between $182 million and $265 million since 2010. BSAI Pacific cod accounts for roughly 60-75% of total annual gross revenues during that period, as estimated by AKFIN (NPFMC 2021, p.111). Revenues from BSAI Greenland turbot ranged from $1.0 million to $10.4 million since 2010, though they have not surpassed $4 million since 2016 and have averaged $2.6 million since 2013.

Five (of six) CDQ groups hold ownership interests in 17 of the 36 LLP licenses in this sector. CDQ groups hold ownership interests in 11 of the vessels actively fishing in the sector (four of six CDQ groups).[7]

Trawl

The A80 sector is the only BSAI trawl sector that can have a directed fishery for Greenland turbot because Amendment 80 allows those vessels to utilize halibut and crab prohibited species catch (PSC) in any target fishery. Harvest specifications do not currently apportion PSC to support directed fishing of Greenland turbot, arrowtooth flounder, Kamchatka flounder, or sablefish by the BSAI trawl limited access sector (trawl CVs).

A80 comprises 27 CP LLP licenses; all are endorsed for the BS area. During the analyzed period, there were typically 18 to 20 A80 vessels active during a given year. Half or fewer fished CDQ, and even fewer of those fished CDQ Greenland turbot (Table 2-4).

The A80 sector is allocated quotas for several BSAI flatfish, Atka mackerel, Pacific cod, AI Pacific ocean perch, and PSC quotas for halibut and crab. Greenland turbot is not allocated to the sector, thus it is taken as a secondary species under area-based limited access TAC. During the A80 era, most of the trawl sector's Greenland turbot catch has occurred while targeting arrowtooth and Kamchatka flounder, although from 2017 through 2019 most of the sector's catch was reported in the Greenland turbot "target" according to NMFS CAS (see Table 5.3 in Bryan et al. 2020, p.29). Other trawl targets where turbot is often retained include rockfish, flathead sole, and Atka mackerel. Greenland turbot are caught incidental to yellowfin sole but in smaller numbers, likely due to the difference in the areas where the species are most commonly found.

Twelve different A80 vessels have targeted Greenland turbot in the BS since 2010. The number of vessels targeting BS turbot in a given year ranged from one to seven. Typically around three-quarters of A80 vessels catch and process some BS Greenland turbot, but not necessarily as a target species as determined by NMFS CAS. No A80 vessel has targeted AI Greenland turbot since 2010, but typically between four and 10 vessels will retain and process some AI turbot. Overall, Greenland turbot accounts for a small proportion of total A80 catch. The 2021 NMFS Annual Inseason Management Report graphically depicts 2017-2021 BSAI trawl catch of Greenland turbot as compared to other flatfish species in slides 29 and 31. For the A80 vessels that *targeted* BSAI Greenland turbot, as a group, the species accounted for between 1.1% and 11.8% of annual gross wholesale value in a given year. Those figures are volatile due to the small number of vessels in each year. Aggregated over the analyzed period, all A80 vessels that processed BSAI Greenland turbot derived roughly 6.4% of their total gross revenue from the species.

CDQ

As noted above, CDQ groups are also stakeholders in the harvest of Greenland turbot. CDQ groups receive allocations of the BS Greenland turbot TAC that may be fished by either trawl or non-trawl vessels. CDQ groups might arrange for TAC to be fished by companies or on vessels in which they have an ownership stake or they might make TAC available to be fished by any permitted vessel and receive a royalty payment in return. The terms of those partnership agreements and the royalty revenue generated

[7] See NPFMC 2021, pp. 152-153.

are unavailable to the analysts at the species level, though total leasing revenues are reported in tax filings.

Utilization of the CDQ reserve depends on demand for Greenland turbot TAC by trawl and non-trawl vessels, which are typically interacting with the turbot fishery as a secondary species to Pacific cod, the key A80 flatfish species, or pollock in the case of AFA CPs. The BS Greenland turbot CDQ reserve has been lightly harvested in recent years. Table 2-4, in the following subsection, reports the size of the CDQ reserve and harvest utilization from 2013 through 2021, which is the full range of years reported on the NMFS Catch and Landings Reports web page (catch and vessel count by gear sector was queried separately by AKFIN and is reported only for FLCC and A80). Low utilization of the CDQ reserve by FLCC might be attributed to the impact of whale depredation on efficiency and productivity, but the ultimate driver is the fact that the non-CDQ TAC is not being fully utilized and thus there is no demand for additional harvest quota. The annual reports published by CDQ groups reveal that partial ownership stakes include FLCC vessels that could conceivably increase their participation in the BS Greenland turbot fishery if the authorization of longline pot gear makes the fishery more effective in the context of whale depredation, and/or if the BSAI Pacific cod fishery becomes less productive.

The CDQ Program is allocated 10.7% of the TAC for Bering Sea Greenland turbot along with other BSAI groundfish species.[8] In 2021, this amounted to 548 mt out of a 5,125 mt BS TAC. Those 548 mt are then divided between the six CDQ groups as follows: APICDA – 16%; BBEDC – 20%; CBSFA – 8%; CVRF – 17%; NSEDC – 19%; YDFDA – 20%. In metric tons, that translated to between 43.9 mt (CBSFA) and 109.7 mt (BBEDC and YDFDA).

2.2.2 Participation, harvest, and revenues for HAL CPs

During the analyzed period, 15 unique HAL CPs targeted BS Greenland turbot. Table 2-2 shows the TAC, the total non-CDQ Greenland turbot harvested by HAL CPs, and the proportion of that catch that occurred in what the NMFS CAS designated as the target fishery. Note that the BS non-CDQ TAC is not allocated solely to the HAL CP sector and, in fact, that the trawl CP sector has increased its catch since the implementation of Amendment 80. The difference between total catch and target catch represents turbot that were retained incidental to catch of other groundfish. HAL CP catch of Greenland turbot largely occurs on hauls where turbot was the target species as designated by NMFS CAS. Table 5.3 in the most recent stock assessment shows that the balance of fixed-gear turbot catch occurs in the Pacific cod and, to a lesser extent, sablefish targets (Bryan et al. 2020, p.29).

Declining catch does not appear to be correlated to the TAC level. The proportion of catch taken in the target fishery, which generally declines beginning around 2017, might indicate that the fishery has become less attractive. There could be many reasons for this, among which whale depredation may certainly be one. Other reasons could include lower market values, international trade policies, and costs or disruptions associated with the COVID pandemic in 2020 and 2021. Whatever the reasons, the reductions in HAL CP catch and participation in 2021 is remarkable.

The vessel counts in Table 2-2 show that BS Greenland turbot was never prosecuted or relied upon by the entirety of the FLCC fleet, but a subset of that sector has targeted turbot throughout the analyzed period. The "vessel targeting" trend reflects that a core group of FLCC vessels continued to make BS Greenland turbot a consistent piece of their annual fishing plans throughout the last decade as total catch declined, but even those vessels ceased targeting in 2021. Those vessels would be the most likely to benefit from a change in gear authorization that might improve the fishery's viability in the context of whale depredation. That said, the number of vessels that could potentially benefit includes the total set that possesses Bering Sea non-trawl gear endorsements on their LLP licenses (see Section 3.1).

[8] 2021 CDQ Group Quota Allocations

Table 2-2 Bering Sea Greenland turbot catch by HAL CPs (mt) and number of vessels (non-CDQ), 2010-2021

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
BS Non-CDQ TAC	*3,587*	*3,500*	*5,296*	*1,438*	*1,481*	*2,186*	*2,272*	*3,719*	*4,356*	*4,356*	*4,356*	*4,356*
Total Catch	1,281	1,631	1,397	564	620	1,053	947	923	250	519	272	0.3
Catch in Target	1,177	1,503	1,319	558	610	1,043	894	816	166	474	221	0
% in Target	92%	92%	94%	99%	98%	99%	94%	88%	66%	91%	81%	0%
Total #Vessels	18	16	13	9	9	8	8	16	16	12	12	3
#Vessels Targeting	9	8	7	3	3	3	5	4	3	3	4	0

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA

Table 2-3 provides context for the revenue dependency of the HAL CP vessels that targeted Greenland turbot in a given year. The table compares the average "per vessel" gross first wholesale revenues generated from Greenland turbot to the total wholesale value generated in all Alaska fisheries. The annual vessel counts are the same as shown in Table 2-2 (bottom row). In aggregate, the HAL CPs targeting turbot derived around 12% of their annual revenue from the species. The median vessel that targeted Greenland turbot was generating around $750,000 from turbot compared to total fishing revenues of $6.86 million (gross, unadjusted for inflation). Total gross revenue from Greenland turbot was highest from 2010 to 2012 ($7.4 million to $10.4 million) and lowest in 2018 and 2020 ($1.0 million, both). Revenue data for 2021 is not currently available but will certainly be the lowest on record and would not appear in this table because no HAL CPs targeted turbot.

Vessel-level revenue dependency is not reportable due to confidentiality and cannot be reported in quartiles given the small number of vessels targeting turbot. What can be stated qualitatively is that two vessels stand out in terms of historical dependence on turbot in terms of the share of total revenue generated. On average, those vessels generated over 20% of their total revenue from turbot. Other vessels have recorded years with over 10% of total revenue from turbot, but none since 2014.

Table 2-3 Average "per vessel" gross first wholesale revenue from BSAI Greenland turbot catch relative to total Alaska revenues for the HAL CPs that targeted Greenland turbot (nominal $millions), 2010-2020

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Avg.	Median
BSAI GT Wholesale Val.	0.67	1.15	1.21	0.49	0.73	1.26	0.87	0.98	0.34	0.75	0.25	0.79	0.75
Total Wholesale Val.	4.92	6.86	6.91	4.76	6.40	7.24	7.71	8.31	7.83	4.82	5.62	6.49	6.86
GT %	*14%*	*17%*	*17%*	*10%*	*11%*	*17%*	*11%*	*12%*	*4%*	*16%*	*5%*	*12%*	*12%*

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA

Table 2-4 reports total harvest of CDQ BS Greenland turbot quota from 2013 through 2021. HAL CPs accounted for only 1.2% of all CDQ Greenland turbot retained in the BS from 2013 through 2021 while A80 vessels accounted for 4.8%. Where there are discrepancies between the total CDQ harvest and catch by the HAL CP and trawl sectors, it reflects CDQ turbot retained in a different sector – typically American Fisheries Act (AFA) CPs. AFA CPs accounted for 93.3% of the total retained CDQ turbot during the analyzed period (over 400 mt).

Table 2-4 Bering Sea Greenland turbot CDQ harvest, by gear type

					Retained G. turbot in mt; (#vessels)	
Year	BS TAC (mt)	CDQ Reserve (mt)	CDQ Harvest (mt) †	% CDQ Utilized	HAL CP	Am. 80
2013	1,610	172	76	44%	-	3.2 (5)
2014	1,659	178	73	41%	* (1)	2.5 (4)
2015	2,448	262	29	11%	* (1)	3.5 (4)
2016	2,558	286	79	28%	* (1)	* (1)
2017	4,187	468	122	26%	2.8 (6)	* (1)
2018	4,904	548	37	7%	0.7 (5)	7.3 (3)
2019	4,904	548	40	7%	0.4 (3)	* (2)
2020	4,904	548	9	2%	1.1 (3)	* (1)
2021	4,904	548	2	< 1%	-	* (1)

† Catch amounts in this column are not confidential because they are published by NMFS (see source note). They do not reveal confidential data in the right-hand columns because total CDQ harvest includes catch by sectors other than HAL CP and Am. 80 (e.g., AFA CP).
Sources: NMFS AKRO SF Annual Catch and Landings Reports. https://www.fisheries.noaa.gov/alaska/commercial-fishing/fisheries-catch-and-landings-reports-alaska, and NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA

Data from 2015 through 2021 reflect that the U.S. Greenland turbot export market is currently down in terms of both volume and value (Table 2-5). Those data, which include all production (fixed-gear and trawl), show that recent gross volume and nominal first wholesale value peaked in 2019 (1.67 million kg; $6.06 million). Average volume and value for 2020 and 2021 were 790,000 kg and $2.35 million. The 2020/21 per-unit values of Greenland turbot exports are significantly lower than in the preceding years. A drop in both production and unit value likely indicates a shift in the demand market. This market situation is generally true of BSAI flatfish and is not unique to BS Greenland turbot.

Table 2-5 Total U.S. exports of Greenland turbot, 2015-2021

	Volume (kg)	Value (USD)	Price/kg
2015	1,053,867	$3,345,668	$3.17
2016	1,249,235	$4,274,170	$3.42
2017	1,244,593	$4,297,925	$3.45
2018	1,073,860	$4,823,850	$4.49
2019	1,672,092	$6,064,997	$3.63
2020	845,977	$2,479,202	$2.93
2021	733,113	$2,223,137	$3.03

Source: NMFS FOSS Trade Data; www.fisheries.noaa.gov/foss, accessed Dec. 2021.

2.3 Killer whale depredation on BSAI hook-and-line gear

The analysts have two available avenues by which to characterize the extent of killer whale depredation on hook-and-line gear in the BS: data from the biennial longline survey of the BS area and fishery data recorded by observers on HAL CPs. The Council may also weigh anecdotal information provided by fishery participants through written or oral testimony. The analysts do not presume to arrive at a number of depredating whales or fully account for their impact on HAL gear catch; whale behavior is complex and their interaction with a fishery that is somewhat pattern-driven in time and space can be confounding. The following information is merely presented for the reader to observe general time trends in observations of whale depredation and draw their own conclusions about the severity of the issue.

The Alaska Fisheries Science Center's (AFSC) longline survey samples the BS in odd-numbered years. Sampling in that area occurs during the first two weeks of June and covers 16 sampling stations. AFSC

staff report that killer whale depredation has been occurring regularly at BS stations for many years, though standardized survey depredation data are only available dating back to 1999.[9] Table 2-6 shows the number of the 16 sampling stations where some portion of survey sets were depredated in each year. Depredation occurred at more than half of the stations in 2009 and in each year from 2013 through 2021. Figure 2-1 illustrates that killer whale depredation is most prominent in the BS management area in terms of the number of sampling stations where depredation occurred. Figure 2-2 shows the proportion of BS longline survey skates that were depredated from 1999 through 2021. A skate of gear is the standard unit of measurement for the longline survey; a skate consists of 45 hooks. The figure shows that the proportion of depredated skates has increased over the analyzed period, leveling off around 50% since 2013.

AFSC staff provided several caveats to consider when using the longline survey as an index of killer whale depredation – particularly as applied to the BS Greenland turbot fishery. First, the relevant portion of the longline survey occurs over a relatively small number of days in a limited, predetermined area. Second, annual participation in colocated fixed-gear fisheries – e.g., HAL Greenland turbot – during the survey period has been inconsistent meaning that sometimes the survey vessel is one of only a few fishing vessels in operation and thus may be targeted more intensely by depredating whales in certain years. Third, observations of depredating whales from one survey station to another during a given year may not be independent as individual whales are known to follow the survey from station to station and may learn over time when/where depredation opportunities will exist.

Table 2-6 Number of Bering Sea longline survey stations (of 16) with killer whale depredation, 1999-2021

Year	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	2019	2021
#Stations with KW depredation	7	5	7	2	7	10	7	11	9	11	10	10

Source: Table 3-11 in 2021 Sablefish stock assessment (Goethel et al., 2021). Available at: https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/sablefish.pdf.

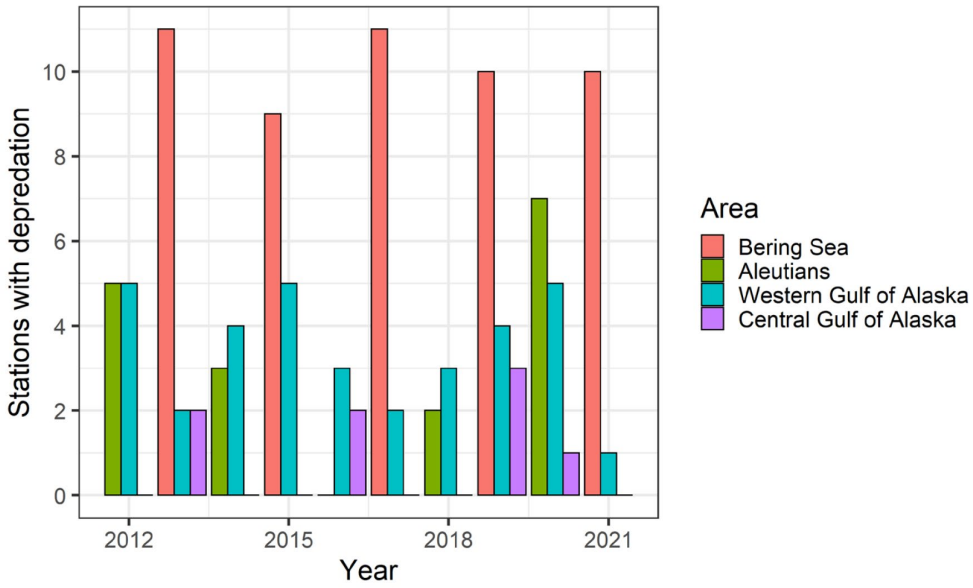
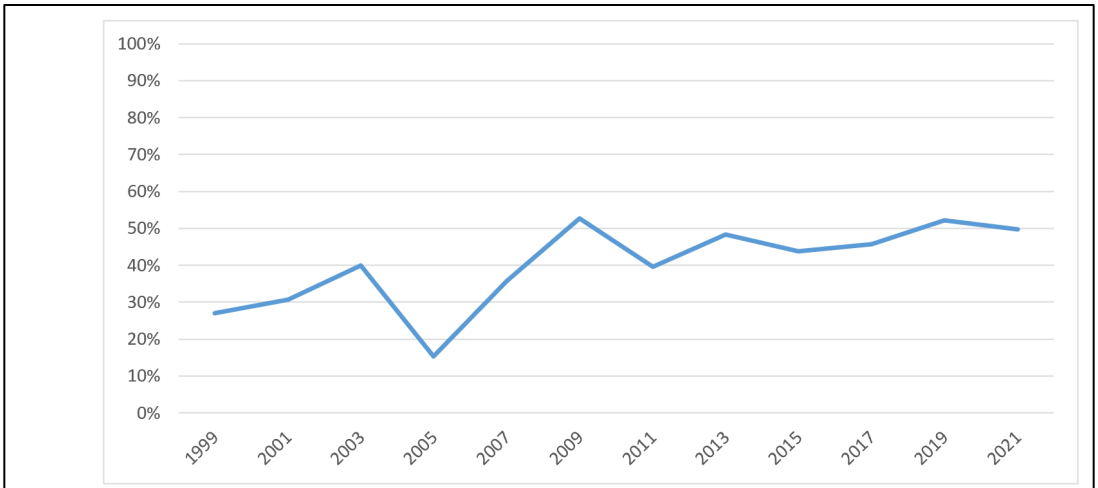


Figure 2-1 Number of AFSC longline survey stations with killer whale depredation by area, 2012-2021 (Source: Siwicke et al. 2021)

[9] Depredated survey sets are removed from the calculations of the Relative Populations Numbers and Weights (RPN and RPW) that are used in stock assessment, including those calculated for Greenland turbot.



Dep. Skates	630	718	933	360	831	1,234	924	1,132	1,024	1,069	1,220	1,164
Tot. Skates	2,331	2,338	2,336	2,342	2,322	2,344	2,338	2,340	2,342	2,341	2,339	2,340
% Depredated	27%	31%	40%	15%	36%	53%	40%	48%	44%	46%	52%	50%

Figure 2-2 Proportion of AFSC Bering Sea longline survey skates where depredation was observed, 1999-2021; odd-number years only (Source: AFSC, personal communication)

Given the caveats above, the analysts also looked to fishery data recorded by observers on vessels, as provided by NMFS FMA. Table 2-7 estimates a percentage of all BS HAL CP hauls where some form of killer whale depredation occurred from 2011 through 2020. For this purpose, depredation is being defined as one or more of the following occurring during an observed haul: killer whales deterred, killer whales feeding on discards, or killer whales feeding on catch. As is evident from the fact that the grey rows in the table sum to more than the number of unique hauls where any depredation occurred, it is often the case that more than one form of marine mammal interaction occurs during a depredated haul. The final estimate requires weighting and extrapolation based on the proportion of HAL CP gear (i.e., hooks hauled) that was actively observed for marine mammal interactions.[10] The table reflects a jump in the estimated percentage of hauls that were depredated occurring around 2016 (7.1%), with the two highest years in the decade occurring in 2019 and 2020 (8.5% and 7.8%). Note that the data used for this exercise includes *all* BS HAL CP fishing – not limited to hauls targeting Greenland turbot.

Table 2-7 also reflects that depredating catch is the most frequently observed type of killer whale interaction (relative to observations of deterrence and/or feeding on discards). To position Greenland turbot within the context of all BS HAL CP hauls, Table 2-8 ranks species by the number of times they were noted by an observer as having been the subject of killer whale depredation. Note that more than one species could have been noted for a given haul. The table shows that Greenland turbot appear to be a preferred target for depredating killer whales. The relative frequency of Greenland turbot identified as compared to Pacific cod is especially notable given that Pacific cod is the predominant catch species for the BS HAL CP sector at large.

[10] The estimated percentage of all hauls where depredation may have occurred is derived as follows. For a given year, the number of hauls where at least one form of depredation was observed is divided by the percentage of gear that was hauled under observation. This extrapolates from observed gear hauling to all gear hauling. That amount of "depredated hauling" is then divided by the total number of hauls to yield the estimate. For example, in 2020 there were 79 observed instances of at least one type of killer whale depredation (hauls where multiple types of depredation occurred are not double-counted). In that year, 18.2% of BS HAL CP gear was observed for marine mammal interaction. The analysts arrive at a 2020 estimate of 7.8% = (79/0.182)/5,548.

Table 2-7 Estimated frequency of killer whale depredation on Bering Sea hook-and-line CP hauls based on observer data, 2011 through 2020 (Source: NMFS FMA Division)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total hauls	13,264	14,219	14,144	16,192	15,029	13,636	12,203	9,008	7,083	5,548
% Total hauled *gear* monitored for marine mammals	25.3	23.9	23.5	24.2	24.4	21.5	22.0	20.4	17.2	18.2
#hauls feeding on catch, feeding on discards, and/or deterred)	92	100	107	92	102	209	144	102	103	79
#hauls deterrence	*17*	*29*	*10*	*2*	*13*	*37*	*25*	*24*	*5*	13
#hauls feeding on discards	*8*	*16*	*5*	*2*	*6*	*7*	*1*	*1*	*3*	0
#hauls feeding on catch	*83*	*87*	*98*	*89*	*84*	*179*	*137*	*92*	*99*	78
Est. %hauls with one or more mammal interaction types	**2.7**	**2.9**	**3.2**	**2.3**	**2.8**	**7.1**	**5.4**	**5.5**	**8.5**	**7.8**

Table 2-8 Number of instances that an observer noted a species as "depredated" by killer whales during Bering Sea hook-and-line CP hauls, 2011 through 2020 (Source: NMFS FMA Division)

Species	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	%
Greenland turbot	22	39	24	12	20	68	59	49	37	26	356	34%
Kamchatka/Arrowtooth/Gturbot - unidentified	40	24	15	18	19	65	39	21	27	13	281	27%
Halibut	11	14	50	44	44	23	36	3	2	21	248	24%
Flatfish (unidentified)	5	8	6	3	6	2		1	20	3	54	5%
Pacific cod	1	1	3	10	3	9	1	4	8	11	51	5%
Sablefish	2	2	1	1		5	1	12		4	28	3%
Unidentified	1				1	7		2	5		16	2%
Other	1			1			1				3	0%
Total	**83**	**88**	**99**	**89**	**93**	**179**	**137**	**92**	**99**	**78**	**1,037**	

Note: "Other" includes flathead sole, Alaska plaice, and grenadier.

For comparison, killer whale depredation on HAL gear has occurred at a lower rate in the AI management area; the total number of hauls and the instances of depredation being noted by observers were also lower. Table 2-9 uses the same method as Table 2-7 and shows that less than 2% of HAL CP hauls in the AI are estimated to have experienced depredation in recent years. Zero gear hauled under observation in the AI has experienced depredation since 2017.

Table 2-9 Estimated frequency of killer whale depredation on Aleutian Islands hook-and-line CP hauls based on observer data, 2011 through 2020 ("C" denotes confidential data; Source: NMFS FMA Division)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total hauls	979	1,107	1,362	698	933	C	782	658	484	688
% Total hauled *gear* monitored for marine mammals	29.8	41.0	45.0	50.0	38.7	30.5	22.5	41.6	17.3	18.4
#hauls feeding on catch, feeding on discards, and/or deterred)	21	9	10	6	4	C	0	0	0	0
#hauls deterrence	*6*	*2*	*6*	*1*	*3*	*C*	*0*	*0*	*0*	0
#hauls feeding on discards	*0*	*0*	*0*	*0*	*0*	*C*	*0*	*0*	*0*	0
#hauls feeding on catch	*18*	*8*	*5*	*5*	*3*	*C*	*0*	*0*	*0*	0
Est. %hauls with one or more mammal interaction types	**7.2**	**2.0**	**1.6**	**1.7**	**1.1**	**2.0**	**0.0**	**0.0**	**0.0**	**0.0**

3 Additional Issues for Consideration

3.1 Potential effect on participation and associated issues

This subsection considers whether authorizing longline pot gear might alter participation in the BS Greenland turbot fishery and factors that could influence the extent of any such change (i.e., maximum versus "likely"). The latter part of this subsection provides a basis for stakeholders who might testify to the Council on whether certain versions of new participation outcomes could affect the voluntary TAC-splitting agreement between the FLCC and A80 cooperatives.

Potential participation

One of the primary questions before the Council at this stage is whether an action would be intended to narrowly benefit FLCC vessels or whether the Council would be content with the possibility of other non-trawl vessels entering the BS Greenland turbot fishery. Simply adding a fifth exception to the Gear

Limitations regulations at §679.24(b)(1) – as described in Section 2.1 of this paper – would permit any vessel named on an LLP license with a BS non-trawl endorsement to fish longline pots for turbot. Limiting an action to the set of LLP licenses in the FLCC – or even to licenses with historical participation in BS turbot – would require a more complex action. It would take further analysis to determine if such an action even falls within existing management authority because, while the HAL CP sector has been defined in statute (see footnote 6), Greenland turbot is not allocated to any gear or operational-type/processing sector.

Presuming that a new longline pot fishery would be available to any holder of the appropriate LLP license endorsements, and assuming that this would remain a "CP fishery," the maximal outcome would be 77 LLP licenses permitted to fish BS Greenland turbot with longline pots. This is far in excess of the historical participation shown in Table 2-2. Of those 77 groundfish LLP licenses endorsed for BS non-trawl CP operation, 36 comprise the FLCC; the other 41 LLPs represent potential participants that would merely need to add a pot gear endorsement to their FFP (at no cost) if they do not already have one.

A large increase in participation does not seem likely given that the TAC was not fully utilized during the relatively stable period of participation that ended around 2016. However, if longline pot gear proves to be an effective tool then it is conceivable that participation from within the FLCC fleet might rebound and other non-trawl CPs might join opportunistically. Factors that could induce a non-FLCC fixed-gear CP to enter the fishery might include the status of the BSAI Pacific cod fishery and the relative cost of gearing up for this new fishery. Low Pacific cod TAC might make Greenland turbot more attractive as a supplemental source of revenue. Fixed-gear CPs that already fish pot gear would face lower barriers to entering the turbot fishery. The pot CPs that currently fish in the BS include vessels targeting Pacific cod, sablefish IFQ, and the rationalized crab fisheries. Among the vessels that currently comprise the FLCC, four are currently using pot gear to fish for either Pacific cod, sablefish IFQ, or both. Sablefish IFQ is currently the only groundfish for which longline pot gear is authorized in the BS; CPs that already fish IFQ with longline pots could be among the most likely to increase participation in Greenland turbot. Five of the six CPs that have fished BSAI sablefish IFQ with pot gear in the last five years (since 2017) are named on LLP licenses that are part of the FLCC.

There are eight groundfish CP LLPs endorsed for Pacific cod pot fishing in the BS. Three of those are held by FLCC members (i.e., endorsed for CP BS HAL Pacific cod). The vessels attached to those licenses do not necessarily fish pot gear at present, but it is conceivable that their owners' history could make reentry into a pot fishery less costly or less onerous in terms of monitoring requirements. The other five Pacific cod pot CP LLPs are also not necessarily active in that fishery but, again, barriers to entry in this new fishery are presumably lower. Pot CPs that are historically dependent on Pacific cod might have additional interest in targeting Greenland turbot due to low cod TAC levels and the recent decline of inseason TAC reallocations from other Pacific cod sectors, upon which they had historically relied to supplement their cod fishery.

Expanding further, crab vessels would presumably have lower gear-related costs to enter a longline pot fishery and might be induced by recent negative trends in certain crab catch limits. Only two or three crab CPs operated from 2018 through 2020, so if it is assumed that a CP-size vessel is necessary to viably prosecute the BS Greenland turbot fishery then the potential for entry is small. Crab CVs are likely to possess the gear that may reduce costs to enter the turbot fishery but they tend to be smaller in length than the typical groundfish CP and – presuming a tender or mothership operation is not economically viable – they would need to have or acquire processing, freezing, and packaging capabilities. Any crab vessel would need to possess or acquire the necessary BS non-trawl CP LLP because crab LLP licenses and groundfish LLP licenses are distinct. BS non-trawl CP groundfish LLPs are relatively inexpensive *if they are not endorsed for Pacific cod fishing*, but low market value does not equate to availability. The market for LLP licenses is generally low in volume, meaning that groundfish LLP licenses would not be available to a large number of potential entrants who do not already possess one.

If further analysis is recommended, staff would need to assess whether a proliferation of longline pot gear might result in grounds preemption or higher likelihood of gear conflict. Greenland turbot is considered to be an arctic species that is at the southern end of its range where the BS fishery occurs. Based on preliminary communication with the stock assessment author and fixed-gear fishery participants, it appears that smaller biomass levels of Greenland turbot result in fewer commercial-size fish moving south, as indicated by their life-history.[11] Fishing in deep water at relatively northern latitudes could mean that a turbot pot fishery has less spatial and depth overlap with areas fished by crab pots and/or trawl vessels that are targeting flatfish in shallower areas (e.g., yellowfin sole).

FLCC – A80 voluntary agreement

Prior to the recent decline in HAL CP participation, there were likely a few years when the 2013 voluntary agreement prevented an inter-sector race for BS Greenland turbot TAC that could have caused directed fishing to close earlier in the year. This cannot be known for sure, but there was enough concern about that outcome in the years leading up to 2013 that the fixed-gear sector petitioned the Council for gear apportionment. The state of the BS Greenland turbot fixed-gear fishery has changed in recent years due to whale depredation and market conditions, but the analysts perceive that the sectors still value this agreement for the future.

Given the private, voluntary nature of the agreement, there is limited value in staff analysts speculating about the future of the TAC-split when alternatives for action have not yet been proposed. With that caveat, the analysts would expect one of three potential outcomes if a new fixed-gear authorization is implemented:

1. No non-FLCC fixed-gear vessels enter the fishery; any reversion to higher TAC utilization rates is covered by the existing voluntary fixed-gear TAC apportionment
2. Non-FLCC fixed-gear vessels enter the fishery; the voluntary agreement is unchanged and catch by non-FLCC vessels is absorbed into the existing voluntary fixed-gear TAC apportionment
3. Non-FLCC fixed-gear vessels enter the fishery; total fixed-gear catch increases substantially such that co-op and non-co-op vessels compete within the limit of the existing voluntary fixed-gear TAC apportionment
    3a. Voluntary agreement is unchanged but fixed-gear fishery pace increases
    3b. Voluntary agreement is renegotiated or breaks down

3.2 Bycatch

3.2.1 Prohibited species

The Council may wish to consider whether a potential increase in the number of pots fishing might increase or decrease bycatch of certain prohibited species – specifically crab, Pacific halibut, and salmon. While the Council might ultimately view this question in the context of a broader shift toward pot gear in Alaska groundfish fisheries, the analysts have focused on the particular part of the BS FMP subarea where the Greenland turbot fishery typically occurs. Table 3-1 and Table 3-2 compare prohibited species catch (PSC) for pot gear and HAL gear from 2010 through 2021.[12] AKFIN supplied data on all pot and

[11] The Greenland turbot SAFE chapter notes that the understanding of spatial distribution by size and age continues to be refined but is challenged by the fact that much of the survey data come from the Bering Sea shelf where small, young turbot tend to be found, and that data from the slope survey do not provide a consistent time series that accounts for important incoming year-classes (Bryan et al. 2020).

[12] Starting in 2010 reflects the decade that is most relevant to the current nature of BS fisheries. Also, PSC estimation beginning in 2010 is the highest quality data available since years prior are not being upgraded with updated estimation algorithms.

HAL catch (CPs and CVs) that occurred in BS statistical areas 521, 523, 524 and 530.[13] Those areas encompass both the Bering Sea slope, where the current HAL CP Greenland turbot fishery is understood to largely occur, and other statistical areas that might be more relevant to the Greenland turbot fishery than, for example, fixed-gear fishing that occurred in the Eastern Bering Sea and elsewhere on the shelf. Unsurprisingly, given the fixed-gear fishing that presently occurs in these statistical areas, 98.3% of the data in the following tables are drawn from trips or hauls that targeted Pacific cod; 1.4% are from trips or hauls targeting Greenland turbot. Nearly 99% of the data are drawn from HAL gear, including all where the target was turbot. The reader should bear in mind the volatility of small sample data if there is a desire to extrapolate PSC rates based on the little amount of pot harvest that has occurred in this area – none of which occurred in a Greenland turbot "target" as defined by the NMFS Catch Accounting System (CAS).

Table 3-1 includes groundfish basis weight ("GF Basis Wt.") as a simple means to standardize PSC rates for each gear, year, and PSC species combination in Table 3-2. The basis weight is the total amount of groundfish catch that occurred. All groundfish catch is included, though most of the trips targeted Pacific cod. The table also lists the total number of vessels fishing the analyzed area in each year.

The robust number of HAL vessels allows some conclusions to be drawn about the relative prevalence of PSC by species for that gear type. The predominant PSC species by weight is halibut; the amount of halibut PSC declined over the analyzed period. Crab PSC – measured in number of animals – was greatest for bairdi Tanner crab followed by blue king crab which is more variable from year to year. Salmon bycatch occurred in low numbers relative to other fisheries. Non-Chinook salmon accounted for the majority of salmon bycatch.

Standardizing gross PSC numbers is useful because it allows the reader to see whether a year-over-year change in the number of crab, halibut, or salmon taken was driven by the amount of fishing effort in the area or by other unobserved factors. Unfortunately, due to low historical effort in the area, this is less easily interpreted for pot gear. The small number of pot vessels operating in the area make crab PSC – perhaps the item of most interest – not only difficult to interpret but also difficult to report due to confidentiality. For example, the highest values of blue king crab and bairdi Tanner crab bycatch occurred in years for which data are confidential. The data show, however, that pot gear in this area has not recently resulted in any PSC of halibut or salmon.

Whether or not a longline pot fishery in this area would continue to produce zero halibut PSC might change in the future depending on gear specifications that might allow for larger pot gear tunnel openings. As noted in the following subsection, pot vessels with halibut IFQ onboard are not restricted to the 9-inch maximum tunnel opening. Also, note that the Council is currently considering a separate action that could modify the tunnel opening restriction when pots are used to harvest sablefish IFQ, creating yet another piecemeal exception to the tunnel opening restriction.[14]

HAL CPs fishing Greenland turbot in the BSAI currently have a halibut PSC limit of 49 mt. A CP using pot or longline pot gear to fish Greenland turbot would not be subject to a halibut PSC limit.[15]

[13] A map of the BS statistical areas is published in regulation as Figure 1 to Part 679.
[14] Removing the 9-inch maximum tunnel opening for vessels targeting IFQ sablefish was added as an option in the Council's "IFQ Omnibus" package in October 2021 (see motion). Final action on the IFQ Omnibus package is currently scheduled for April 2022.
[15] The total BSAI non-trawl halibut PSC limit is 710 mt; 661 mt of that limit is currently specified for vessels directed fishing for Pacific cod and the remaining 49 mt is for all other non-trawl groundfish fishing *except* when using pots, jig gear, or fishing HAL for sablefish. See Harvest Specifications Table 17.

Table 3-1 Bycatch of prohibited species in western Bering Sea by gear, 2010-2021 (top panel: HAL gear; bottom panel: pot gear). All species in 'number of animals' except halibut (metric tons). RKC = red king crab; BKC = blue king crab; BTC = bairdi Tanner crab; GKC = golden king crab; OTC = opilio Tanner crab. Confidential data denoted by *

HAL	RKC	BKC	BTC	GKC	OTC	Hlbt. (mt)	Chinook	Non-Chnk	GF Basis Wt.	#Vessels
2010	146	368	4,084	420	0	773	0	55	65,038	56
2011	210	1,046	3,004	255	0	798	21	113	76,235	52
2012	70	1,023	2,817	319	0	672	25	260	72,332	66
2013	68	464	2,187	213	0	164	0	102	56,896	28
2014	135	636	2,871	206	0	179	0	114	71,913	29
2015	158	253	3,108	273	0	113	26	66	82,325	45
2016	215	779	4,229	153	4	98	19	152	113,015	44
2017	133	553	4,178	114	9	85	19	123	112,559	47
2018	109	519	1,984	70	42	57	43	153	98,990	50
2019	26	601	2,447	26	27	35	22	305	78,593	35
2020	19	1,051	2,464	25	12	63	20	127	75,414	32
2021	171	259	2,437	24	13	48	6	30	61,907	24

POT	RKC	BKC	BTC	GKC	OTC	Hlbt. (mt)	Chinook	Non-Chnk	GF Basis Wt.	#Vessels
2010	*	*	*	*	*				*	2
2011	258	0	1,241	4	233				264	4
2012/13	No pot fishing								-	-
2014	*	*	*	*	*				*	1
2015	*	*	*	*	*				*	1
2016	76	2,820	8,600	0	0		Zero PSC		2,708	3
2017	*	*	*	*	*				*	2
2018	26	3,811	13,637	0	0				1,650	3
2019	16	2,948	767	10	0				1,554	3
2020	8	0	719	2	1				714	3
2021	*	*	*	*	*				*	2

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC

Table 3-2 Bycatch rate of prohibited species in western Bering Sea by gear, 2010-2021 (top panel: HAL gear; bottom panel: pot gear). Calculated as 'number of animals per metric ton of groundfish catch' except halibut (metric tons per metric ton of groundfish). RKC = red king crab; BKC = blue king crab; BTC = bairdi Tanner crab; GKC = golden king crab; OTC = opilio Tanner crab. Confidential data denoted by *

HAL	RKC	BKC	BTC	GKC	OTC	Hlbt. (mt)	Chinook	Non-Chnk
2010	0.002	0.006	0.063	0.006	0.000	0.012	0.000	0.001
2011	0.003	0.014	0.039	0.003	0.000	0.010	0.000	0.001
2012	0.001	0.014	0.039	0.004	0.000	0.009	0.000	0.004
2013	0.001	0.008	0.038	0.004	0.000	0.003	0.000	0.002
2014	0.002	0.009	0.040	0.003	0.000	0.002	0.000	0.002
2015	0.002	0.003	0.038	0.003	0.000	0.001	0.000	0.001
2016	0.002	0.007	0.037	0.001	0.000	0.001	0.000	0.001
2017	0.001	0.005	0.037	0.001	0.000	0.001	0.000	0.001
2018	0.001	0.005	0.020	0.001	0.000	0.001	0.000	0.002
2019	0.000	0.008	0.031	0.000	0.000	0.000	0.000	0.004
2020	0.000	0.014	0.033	0.000	0.000	0.001	0.000	0.002
2021	0.003	0.004	0.039	0.000	0.000	0.001	0.000	0.000
POT	RKC	BKC	BTC	GKC	OTC	Hlbt. (mt)	Chinook	Non-Chnk
2010	*	*	*	*	*	-	-	-
2011	0.976	0.000	4.697	0.016	0.882	-	-	-
2012/13	No pot fishing							
2014	*	*	*	*	*	-	-	-
2015	*	*	*	*	*	-	-	-
2016	0.028	1.041	3.176	0.000	0.000	-	-	-
2017	*	*	*	*	*	-	-	-
2018	0.016	2.309	8.263	0.000	0.000	-	-	-
2019	0.010	1.897	0.494	0.006	0.000	-	-	-
2020	0.011	0.000	1.006	0.003	0.001	-	-	-
2021	*	*	*	*	*	-	-	-

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC

The HAL CP Greenland turbot fishery generally occurs along the Bering Sea slope between the Zhemchug Canyon and the US-Russia boundary, though some fishing does occur south of the canyon. Figure 3-1 shows bycatch of crab species in pot gear for the Bering Sea in 2021 (contour line on maps is the BS slope). Golden king crab (bottom left) is the only species for which pot bycatch occurred along the BS slope where the Greenland turbot fishery has historically operated. That said, the small amount of pot gear effort along the slope – as shown in the tables above – does not provide a solid basis for forecasting potential crab bycatch by species. The maps do indicate, however, that pot bycatch of bairdi Tanner crab, opilio Tanner crab, and red king crab tends to be concentrated closer to the mainland coast and in waters more shallow than where the Greenland turbot fishery occurs. No pot bycatch of blue king crab was recorded in 2021, but Table 3-1 reflects that blue king crab have been taken in "western BS" pots (as defined in this paper) in previous years. The analysts suggest that the reader not overinterpret historical bycatch data given the low amount of pot effort in the area of interest.

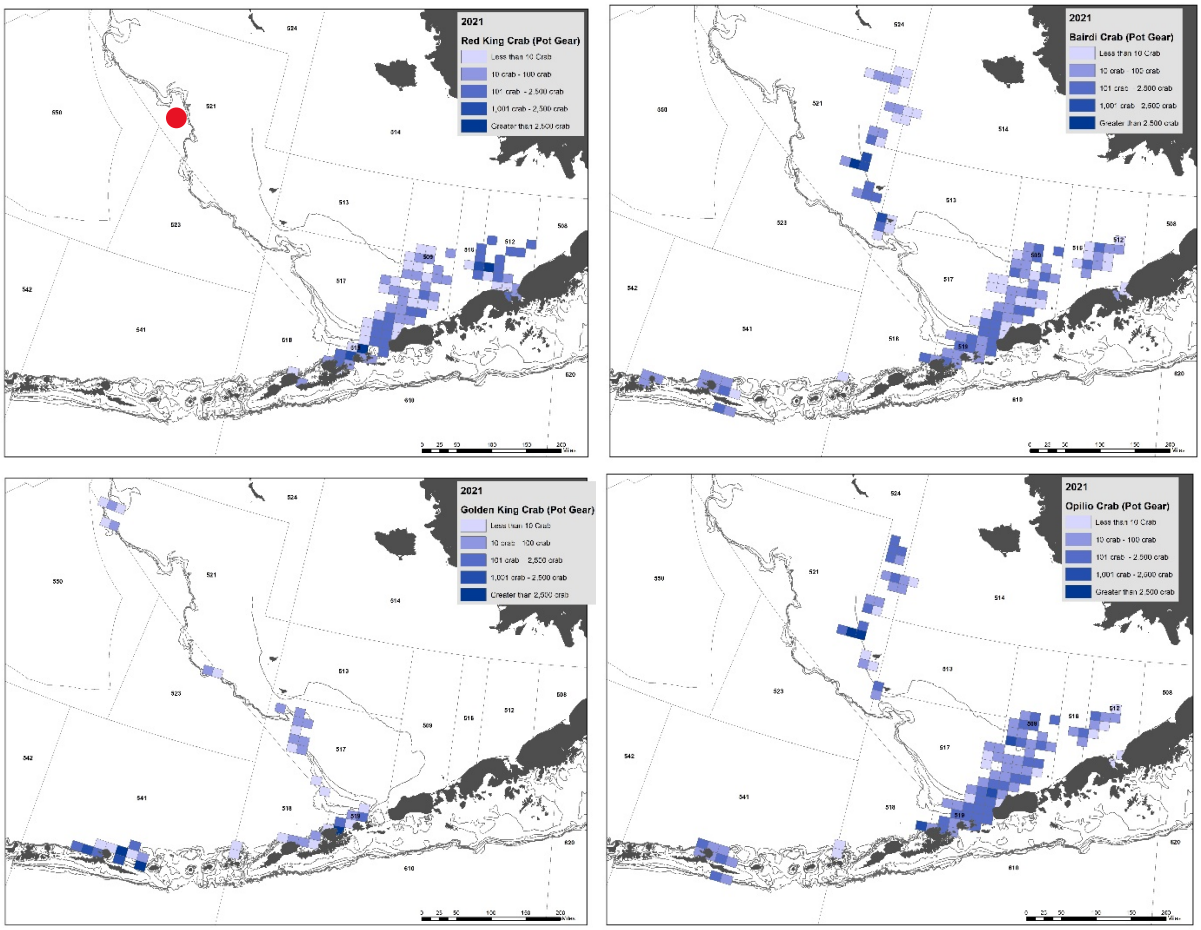


Figure 3-1 Bycatch of crab (number of animals) in pot gear in the Bering Sea, 2021. Clockwise from top left: bycatch of red king crab, bairdi Tanner crab, opilio Tanner crab, and golden king crab. No bycatch for blue king crab occurred in pot gear in 2021. The Greenland turbot fishery is known to occur along the Bering Sea slope which is depicted by bathymetry lines. Zhemchug Canyon is indicated by the red dot in the top-left panel. (Source: NMFS Catch Accounting System, December 2021)

The reader should note that the BSAI fixed-gear sectors do not operate under "hard cap" PSC limits for crab. In other words, there is not maximum permissible number of crab bycatch in the sector(s) that would trigger an immediate closure of directed fishing in a crab bycatch limitation zone. If the catch and bycatch of a crab stock were to approach the OFL during a year, NMFS could implement in-season closures under the In-season Management Adjustment authority (§679.25) to close fisheries that are contributing to removals to prevent an overage. (Note that the crab species listed in the tables above are managed as specific stocks based on their area – e.g., Bristol Bay red king crab or Pribilof Islands blue king crab.) Most crab fisheries are managed on a year that runs from July 1 to June 30 of the following calendar year.[16] Given the typical timing of the Greenland turbot fishery (May through August), it is at least conceivable that a "new" longline pot fishery could begin harvesting as a crab stock is nearing the end of a fishing year where the crab OFL is of concern to fishery managers. If there were to be an OFL-related closure prior to June 30, it is possible that the longline pot groundfish fishery could reopen on July 1 at the start of a new crab OFL year.

[16] Exceptions are Pribilof Islands golden king crab and Norton Sound red king crab. Those stocks are managed on the calendar year.

The analysts do not speculate here about whether the area and depth of a potential longline pot fishery for Greenland turbot will overlap with crab stocks that are overfished or have particularly low OFLs and ABCs. Greenland turbot generally occur in deep water while many crabs do not. However, that fact does not preclude the possibility of bycatch and, moreover, the depths that crab inhabit may change in the future as environmental conditions evolve.

Two other issues related to crab bycatch in Greenland turbot longline pots may warrant further consideration. In both cases there is little or no historical data to which the analysts can point. First, the Council might be interested whether additional crab bycatch in a groundfish fishery would increase instances of mishandling. Second, it is unknown whether a Greenland turbot longline pot fishery will adopt the relatively new "slinky pot" design and whether those pots will perform well at the depths and ocean conditions where turbot are found in the western part of the BS FMP area. As it relates to crab bycatch in those conditions, it is unknown whether slinky pots will fish differently for king crab and whether those interactions will result in different rates of injury and, thus, successful careful release.

3.2.2 Additional considerations for IFQ Species

A vessel targeting Greenland turbot with longline pots that possesses halibut or sablefish IFQ would be required to retain those species up to the amount of their quota during the IFQ season. Bycatch of halibut that occurs outside of the IFQ season, occurs on a vessel that does not possess IFQ, or is under the legal size limit could not be retained. Non-retainable halibut must be released with a minimum of injury. It may be the case that halibut caught in pots would come onboard with less potential for injury compared to HAL fishing because any injury-causing events that might take place at the roller would not occur (e.g., gaffing). Sablefish caught with fixed-gear on a vessel without an IFQ permit may not be retained unless the vessel is fishing on behalf of a CDQ group.[17]

Vessels that have unfished halibut IFQ onboard are not restricted to a maximum 9-inch pot tunnel opening (BSAI Groundfish FMP Amendment 118). If a vessel does not possess halibut IFQ then the 9-inch maximum tunnel restriction would apply. Presuming the vessels prosecuting this fishery are CPs, the halibut IFQ onboard would need to be derived from Class A quota shares.

The Council and NMFS would need to consider how mixed landings of IFQ species and Greenland turbot would be recorded. IFQ landings require a prior notice of landing (PNOL).

3.3 Marine mammals

The primary issue of interest regarding effects on marine mammals would be a potential change in the number of vertical lines (anchor lines) deployed by fixed-gear vessels that might increase or decrease the odds of entanglement with protected species such as humpback whales, fin whales, or North Pacific right whales. Given that HAL gear and longline pot gear sets would be fished with the same number of vertical lines – likely one, but no more than two – NMFS has preliminarily determined that this action is not likely to increase entanglement risk if the total number of sets remains similar.

Marine mammal entanglements generally occur when whales encounter vertical lines that extend from a pot or string of pots set on the ocean bottom to a buoy at the surface (sometimes referred to as "float lines"). The likelihood of entanglement in any one vertical line is the same, regardless of whether the line is part of a HAL set or attached to a pot. However, due to the weight of pots, lines with pots attached are potentially more likely to lead to serious injury or mortality as they make it more difficult for an entangled animal to swim/feed/breathe than a non-weighted, single line (Andersen et al. 2008). Large whales, including right whales, humpback whales, fin whales, and grey whales, are particularly susceptible to becoming entangled in pot gear due to spatial overlap with fisheries and their feeding behavior. Baleen whale entanglements in fishing gear generally involve humpback whales, though

[17] §679.7 Prohibitions (f)(3)(ii)

incidental take of other baleen whale species have occurred. Overall, fewer killer, sperm, or other toothed whales have been entangled in all gear types, including pot gear. The amount of slack line used and the profile of the lines in the water column can influence the potential for entanglement. Generally, lines that remain relatively tight are less likely to lead to entanglement as opposed to lines that create larger profiles in the water if they are relatively loose and/or winding around in loops.

The effect of any potential action would hinge on the net directional shift in total fixed-gear effort (i.e., HAL plus longline pot). That shift would depend not only on a gear-type authorization that makes the BS Greenland turbot fishery more attractive, but also the state of the Greenland turbot resource – i.e., TAC – and its market attractiveness as a primary or supplementary fixed-gear CP fishery in the Bering Sea. The Council might also solicit public comment on whether the introduction of longline pot gear would require additional sets to be made, as compared to HAL gear, to harvest the same amount of fish, thus resulting in additional vertical lines per unit of catch.

Reducing the amount of HAL gear in the water, relative to pot longline gear, might reduce the risk of entanglement to any whale species that is attracted to HAL gear by virtue of exposed, hooked fish upon which to feed. Killer whales and sperm whales are the two species of whales that are most often involved in depredation events, with killer whales being more active in the Bering Sea. Killer whale depredation in the BSAI occurs where high-value longline fisheries overlap with regions supporting some of the greatest densities of "fish-eating" or resident killer whales in the world (Forney and Wade 2006; Fearnbach et al. 2014), and whales seem to target fishing grounds with higher CPUEs (Peterson and Carothers 2013). Killer whales prey upon several groundfish species that are caught on longline gear in Western Alaska, including sablefish, Greenland turbot, arrowtooth flounder and Pacific halibut (Yano and Dahlheim 1995; Peterson et al. 2013). This reduces fishery catch rates and decreases the accuracy of stock assessments. In a survey of Alaska longliners carried out by Peterson & Carothers (2013), the majority of respondents (70.7%) that reported interactions with killer whales (primarily western Alaska) estimated that depredation rates exceeded 40% of catch. In 2013, Peterson et al. used NMFS sablefish longline survey data to explore spatial and temporal trends in killer whale depredation and to quantify the effect of killer whale depredation on catches of groundfish species in the BS, AI, and WGOA. When killer whales were present during survey gear retrieval, whales removed an estimated 54% to 72% of sablefish, 41% to 84% of arrowtooth flounder and 73% of Greenland turbot.

Fishing with pots reduces the threat of depredation by enclosing fish within durable enclosures that whales cannot access. Eliminating the opportunity for easy depredation would discourage whales from targeting vessels, which would decrease the chances of an entanglement event. However, as some of the directed fishery for Greenland turbot would likely continue to use HAL gear, killer whales cued to the cavitation sounds and harmonic frequencies emitted by hauling vessels (Thode et al. 2015) would not necessarily know which vessels would offer an opportunity for depredation. The risk of entanglement to killer whales might therefore not significantly decrease until a majority of the directed Greenland turbot fishery switched to pots. This entanglement risk due to depredation is further complicated by the potential use of slinky pots. There is currently no data on the ability of marine mammals to depredate from gear that uses slinky pots. It should also be noted that the entanglement risk in pot gear for killer whales is relatively low, with one observed interaction (Southeast Alaska pot gear, 2016) in the last five years (Muto et al. 2021).

In evaluating marine mammal risk factors related to shifting from HAL gear to longline pot gear, NMFS staff also identified a potential difference in line diameter, material performance, and breaking strength. While this topic cannot be objectively assessed with available data, the Council might consider it with the aid of public comment and any data available from other Council or NMFS regions. The groundline connecting pots is generally understood to be stronger, or of a greater diameter, than the line from which hooks are baited on gangions. Stronger, thicker line might be less likely to break and release an entangled marine mammal, but that effect might be counterbalanced by the fact that thicker line is less likely to wrap tightly around parts of the animal. It is likely that a shift towards longline pot gear would result in

heavier groundline being deployed, on average, but the effect of that change on marine mammals is unknown or warrants further study that is beyond the scope of this discussion paper. Moreover, participants in other longline pot fisheries have recently begun to deploy lighter pots (i.e., "slinky pots") that might use lighter line than conventional pots. Given that reliance on pot gear for BS Greenland turbot fishing would be a new phenomenon, the Council may benefit from public comment about the types and properties of the gear that would be used in this relatively deep-water fishery. Note that existing regulations to not distinguish between conventional pots – which come in many shapes and designs – and the relatively novel slinky pot design.

3.4 Observer Program and monitoring

CP vessels operating in the BS or AI are typically in the "full coverage category" of the Observer Program.[18] All vessels that have fished Greenland turbot during the analyzed period were in full coverage. Full coverage CPs carry at least one fishery observer at all times regardless of which gear type is being deployed. The potential action discussed in this paper would not directly affect observer coverage levels, though the number of deployed days could increase if total fixed-gear effort increases. A caveat to consider is that the FLCC is a special kind of cooperative with specific monitoring requirements that are defined in regulation at §679.100 (Subpart I). Those requirements are only applicable when directed fishing for Pacific cod. Further examination may be necessary to determine what monitoring is required of HAL CPs when directed fishing for Greenland turbot, regardless of whether the vessel is part of the FLCC (regulatorily defined as the "Longline Catcher/Processor Subsector"; see footnote 6).

The analysts consulted NMFS Fisheries Monitoring and Analysis Division (FMA) and the NOAA Office of Law Enforcement (OLE) for a preliminary scan of challenges that could result from a new gear authorization in this fishery. The primary issue raised was whether observers on CPs deploying pot gear would have adequate and safe access to *unsorted* catch, given that catch is brought onboard during a pot haul in a different manner than during a hook-and-line haul. Some of the major differences between observer sampling and safety protocols for pot hauls versus hook-and-line hauls are described on Page 2-6 of the NMFS Observer Sampling Manual.[19]

Catch must be reported by gear type, even if a vessel fishes multiple gear types on the same trip. On CPs with full observer coverage, the catch data is reported by gear since observers record the gear deployed at the haul-level. In addition, CPs fishing multiple gear types would submit separate reports by gear for their Daily Production Reports and landing reports. If a CV were to utilize both longline pot and HAL gear on a single trip, the vessel would need to create two landing reports at the end of the trip. No vessel may fish both pots and hooks on the same longline set.

NMFS FMA staff noted that as many as five active FLCC vessels are set up to for pot fishing and compliance with observer protocols for pot gear due to participation in other pot fisheries (Source: pers. comm.). Any other HAL CP that elects to fish longline pot gear could incur costs or need to implement operational modifications to accommodate observers on deck in terms of safety and compliance. A vessel's previous experience with pot gear might positively influence the likelihood of entering a BS Greenland turbot longline pot fishery due to lower costs of deck reconfiguration and gear acquisition. However, the analysts presume that participation in this new gear/species fishery is more likely to be influenced by opportunity costs. In other words, any vessels that might take up this gear type would be

[18] A non-trawl CP may request to be placed in the partial observer coverage category if it falls below a maximum weekly groundfish production limit, as established at §679.51(a)(3). Two CPs that have fished Greenland turbot at a time in the past have applied for and received partial coverage status but those vessels did not fish for turbot during any of those partial coverage years.
[19] NMFS 2021 Observer Sampling Manual, accessed 10/26/2021.

reacting primarily to the relative availability and value of Greenland turbot under reduced pressure from whale depredation as opposed to the costs of conversion and observer accommodation.

Vessels with no previous participation in pot fishing could elect to use pot gear and would thus need to coordinate with NMFS and comply with the monitoring protocols that are specific to pot gear.

Finally, the Council should recall that NMFS has previously noted its intent to modify monitoring requirements for CPs using pot gear to improve data quality and timeliness. This was most recently discussed when the Council reviewed an analysis of reducing the number of BSAI pot CP LLP licenses in February 2021 (no action was taken). Section 3.7.1 of that public review draft (p.69) outlines data collection challenges in the Pacific cod pot CP fishery and proposes modifications that NMFS can implement under its management authority.[20] Those suggested modifications are similar to what is currently required for CPs using pot gear to fish CDQ Pacific cod. Given the likely small size of a BS Greenland turbot longline pot CP fishery, any such fishery could face similar challenges and might be subject to the same or similarly enhanced monitoring requirements. The monitoring enhancements that NMFS previously suggested for groundfish pot CPs are:

- Require observers deployed on BSAI pot CPs participating in the BSAI groundfish fisheries to have a level 2 deployment endorsement;
- Ensure that BSAI pot CPs participating in the BSAI groundfish fisheries comply with the pre-cruise meeting requirements before beginning a fishing trip;
- Require BSAI pot CPs participating in the BSAI groundfish fisheries to provide a certified observer sampling station and motion compensated platform scale for the observer's use.

NMFS's justification for those suggestions and preliminary cost estimates are provided in the document referenced above.

4 Summary of Issues

The Council's immediate task is to determine whether to move forward by developing a purpose and need statement and alternatives for analysis. The Council may rely on this paper, public comment, and any recommendation received from its Advisory Panel. If the Council's preference is for a straight-forward regulatory amendment that adds an exception to the prohibition on the use of longline pot gear, then the alternatives could be simple. If the Council prefers to consider alternatives or options that prescribe "who" could utilize longline pot gear for BS Greenland turbot then NMFS and Council staff would need to assess how that fits into Federal regulations and aspects of the FMP that govern this fishery, which is not allocated as a limited access privilege program (LAPP). The Council could request additional information or move directly to initial review of an Environmental Assessment and Regulatory Impact Review.

This paper includes data strongly suggesting that killer whale depredation is negatively impacting the HAL CP fishery for Greenland turbot (Sections 2.2.2 and 2.3). If the Council presumes that the use of longline pot gear would improve the viability of the fishery – all else equal – then the first pair of questions to be answered are: Who *could* use longline pots? and Who *would* use longline pots. The answer to the first question could be as straight-forward as "any vessel named on one of the 77 LLP licenses with a BS non-trawl endorsement". The answer to the second question would depend on a number of factors that would change over time and involve individual decision making by participants. Those factors include the harvest efficiency of longline pot gear in this fishery, cost effectiveness at the individual level (including new gear and/or deck modifications for fishing and monitoring), the market

[20] With concurrence from the Council, NMFS would initiate rulemaking to implement monitoring requirements under MSA section 305(d) regulatory authority, consistent with Section 3.9 of the BSAI Groundfish FMP.

value of processed-at-sea Greenland turbot, catch limits and markets for other species available to this set of vessels (i.e., opportunity cost), and whether a particular vessel fishes other species for which longline pots are authorized and effective (e.g., sablefish IFQ).

The Council could identify issues for future analysis by anticipating what might happen if the number of vessels fishing BS Greenland turbot with longline pot gear increases or if the aggregate catch increases. The following paragraphs highlight six issues (or issue categories) that were among the points covered in this paper (**bolded below**): competition between FLCC and non-FLCC vessels; how Pacific cod catch would be debited against certain cod sector allocations or incidental catch allowances; bycatch of prohibited species and non-target groundfish or ecosystem species; impacts on marine mammals; fishery monitoring and compliance; and the extent to which the fishery is reflected in the data used for stock assessment. Whether – or the extent to which – these issues could become concerns to the Council largely depends on how participation and catch rebound as a result of longline pot gear authorization. If the fishery reverts to the relatively modest levels seen roughly 5-10 years ago then the resulting fishery dynamics would look familiar but there could be environmental or monitoring impacts due to the substitution of pots for hooks. If the fishery expands then the Council would need to consider issues related to competition within the fixed-gear sector and with other gear sectors *in addition to* environmental and monitoring issues.

A revitalized BS Greenland turbot fishery could increase **competition** in two ways (Section 3.1). First, if non-FLCC fixed-gear vessels enter the fishery in a significant way then FLCC vessels that depend on turbot might engage in a race when the season opens in May or when fishing conditions are good. Those FLCC vessels would not lose out on Pacific cod catch but might have to alter their fishing plan. A faster paced turbot fishery could affect the measures that vessels targeting turbot take to minimize bycatch or could affect incentives to avoid gear conflict, among other things. Second, if total fixed-gear turbot catch grows to the limit established by the voluntary private TAC-splitting agreement between FLCC and A80 then co-op vessels could cede part of their fixed-gear allotment to other participants or, alternatively, the voluntary inter-sector agreement in place since 2013 could be reopened. If the turbot fishery is only prosecuted by FLCC member vessels then competitive effects could be minimal. While the FLCC's internal voluntary agreements only cover Pacific cod fishing, its membership already possesses the cooperative structure and tools to fish rationally and/or reach internal settlements. The high value of the Pacific cod fishery provides a strong incentive to ensure that a secondary species does not destabilize the subsector.

In certain cases, new or increased effort in the Greenland turbot fishery could affect **how Pacific cod catch is debited from sector allocations of the TAC** if vessels are using longline pots (Section 2.1). First, the vast majority of CP LLP licenses with a BS non-trawl endorsement are not endorsed to fish Pacific cod with pot gear (69 of 77). CPs with those licenses must retain Pacific cod caught while targeting turbot with pots up to the MRA and all of their Pacific cod catch would accrue to the BSAI HAL/Pot ICA. An increase in the number of vessels without Pacific cod pot endorsements that are fishing longline pot gear could increase utilization of the ICA. Each HAL and pot sector "contributes" to the ICA, so if fishery managers need to increase the size of the ICA then directed fishing allowances for all HAL and pot sectors would be reduced. Whether or not this poses a management challenge is unknown at this time and depends on future participation. Second, the other eight relevant CP LLP licenses are endorsed for Pacific cod pot gear. Vessels with those licenses must retain all Pacific cod when directed fishing for pot CPs is open, and that catch accrues to the Pacific cod TAC allocation for BS pot CPs. The Pacific cod pot CP TAC is relatively small and has been fully harvested by fewer than the maximum number of eight CPs that could conceivably participate. In that sense, additional utilization of the Pacific cod pot CP TAC by vessels that have not been targeting pot cod comes at a cost to the core participants in that sector – two to four vessels in recent years. However, this concern may be moot since A season Pacific cod pot CP directed fishing openings are typically short – closing before the turbot fishery opens in May – and when directed fishing is closed *all* Pacific cod catch accrues to the BSAI HAL/Pot ICA.

Regardless of whether longline pot adoption significantly increases effort or merely substitutes for the historical level of hook-effort, a gear swap is likely to change the fishery's **bycatch** species profile. Section 3.2 makes the most relevant available data comparison between HAL and pot bycatch in the western BS. It is possible that a shift from HAL to longline pots would broadly shift PSC from a mix of halibut and crab species to "mostly crab". There is little pot gear data to draw from in the western BS, but crab are probably more likely to be caught in pot gear. The data that are available showed that Pacific cod pots in the western BS mostly encountered bairdi Tanner crab and blue king crab. That said, Greenland turbot are typically found in deeper waters so the most relevant pot bycatch data would come from turbot pots, which have not been fished in the past. Vessels fishing pot gear with no halibut IFQ onboard would be restricted to a 9-inch pot tunnel opening; that would not make halibut bycatch impossible but it could reduce the rate relative to HAL gear. The Council might also consider whether shifting to pots could change the mix of non-turbot FMP or ecosystem species that are taken in the fishery and either discarded or retained up to the MRA. There are few data that show how pots will perform in the relevant area, but individuals familiar with the fishery have suggested that pots could reduce the effort wasted on non-market species such as grenadier that often end up on turbot hooks at certain depths.

A regulatory amendment analysis would need to fully consider whether authorizing longline pot gear could adversely affect **marine mammals** or other environmental components like sea birds or habitat. Section 3.3 highlighted several key considerations relative to potential impacts on marine mammals. First, pot gear might reduce interactions with whales that are attracted to exposed, hooked fish. Second, if the fishery is split between HAL and pot vessels then whales might still approach longline pot gear because they are attuned to the non-specific sound of gear hauling. Third, the net effect on marine mammal interactions likely depends on whether the fishery switches *completely* to pots and whether longline pot fishing requires more sets (i.e., more vertical lines) to catch the same amount of target fish. Fourth, the Council might need to seek public input on the specifications of the gear that would be used for longline pots – such as line diameter, breaking strength, etc. – to assess whether gear interactions would pose more danger to marine mammals than when HAL gear is being fished.

The Council may consider whether allowing CPs to utilize multiple types of fixed-gear – i.e., HAL and pots – on a single voyage imposes additional costs or burdens on the Observer Program and whether it increases compliance **monitoring** costs for the affected participants. Further analysis would pay close attention to what burdens are *additional* because single pot gear is already authorized and monitored in the BS – it just so happens that it is not utilized in the Greenland turbot fishery. Monitoring requirements for pot CPs differ from those of HAL CPs, and pot CPs might face additional monitoring requirements in the future (see end of Section 3.4). Any vessel fishing multiple gear types faces additional reporting requirements, even when operating under full observer coverage. Fleet compliance costs might be a secondary concern because the authorization of longline pot gear in the BS creates a voluntary option, not a requirement. That said, if prosecution of fixed-gear BS Greenland turbot is not economically viable without longline pot gear then the Council might take an interest in making longline pot adoption an attractive means to obtain optimum yield.

A full analysis would provide deeper background on what is known about the stock and life-history of Greenland turbot and how it intersects with the BS groundfish fishery. In this paper, that information is incorporated by reference to Bryan et al. (2020). According to the lead **stock assessment** author, it is not possible to predict whether a significant shift to pot gear would affect the precision of survey estimates because there is scarce history of fishing turbot with pots and thus little is known about size selectivity for that gear (M. Bryan, pers. comm. 2021). The Greenland turbot assessment has always been challenging with respect to length composition because much of the survey data come from surveys on the BS shelf where turbot is generally understood to be younger and smaller. That said, the stock assessment model is fit to both survey and fishery length composition data so catch in pot gear would be reflected after some period of time following authorization.

If the Council's review of this agenda item identifies concerns that could rival or outweigh the presumed benefit of mitigating whale depredation, then subsequent analyses would provide greater detail on the importance of the BS Greenland turbot fishery for individual and collective entities that could participate in this new mode of fishing and for those that are likely to participate. That analysis would allow the Council to qualitatively assess the net benefits of a future action at a broad level. The analysts have not concluded that particular concerns exist but, to summarize, this paper has touched on: pot bycatch of certain species, impacts on marine mammals, additional monitoring requirements, potential changes in aggregate participation, gear conflict, and grounds preemption.

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