GOA Trawl Sweeps modification
Discussion Paper
February 2011

In October 2010, the Council initiated a trailing amendment to require trawl sweep modifications on non-pelagic trawl vessels fishing in the Central Gulf of Alaska (GOA). The action was initiated in conjunction with final action on the GOA Tanner crab bycatch measures. A similar gear modification, which requires elevating devices to be placed on the trawl sweeps to lift the sweep off the seafloor, was implemented beginning in 2011 for flatfish vessels in the Bering Sea. Bering Sea research has demonstrated that elevated sweeps can reduce unobserved mortality of crab from interacting with the trawl sweeps.

Unlike the modification required to the Bering Sea (BS) trawl sweeps, however, which is required only in the directed flatfish fisheries, the proposed trawl sweep modification for the Central GOA would apply to all non-pelagic trawl fisheries (e.g., flatfish, Pacific cod, pollock, and rockfish). These other target fisheries were not included in the BS trawl sweep modification amendment, and the BS analysis did not address whether sweep modifications would work effectively for other target fisheries. The Council spent time during the October Council meeting debating the merits of whether the trawl sweep modification should apply to all trawl target fisheries, and whether it should be required GOA wide, or be limited to only the Central GOA. By including the western GOA trawl fleet in this proposed amendment, the Council was concerned that they could be requiring a gear modification for a fleet of largely small vessels, on which the trawl sweep modification has, to date, not been tested.

During the October 2010 discussions, the Council recognized that there are some outstanding questions with respect to the extent research is necessary to ensure that the modifications are practicable in the fleet, and meet the Council's intent to reduce crab mortality. Given these outstanding issues, the Council requested staff prepare a brief discussion paper. The paper includes a discussion on the practicality of trawl sweep modification for different non-pelagic GOA fisheries, a discussion of the effectiveness of the modification at reducing crab bycatch in the non-pelagic GOA fisheries, and a brief outline of the proposed steps for verification of lift achievement and a testing plan. Much of the information in the discussion paper is based on a letter presented at the December 2010 Council meeting that was written by John Gauvin, Alaska Seafood Cooperative, and Julie Bonney, Alaska Groundfish Databank, in consultation with Dr. Craig Rose, NMFS.

Is the trawl sweep modification practicable for GOA trawl fleets?

What type of vessels are required to use sweep modifications now in the Bering Sea?

In the BS, vessels directed fishing for flatfish are required to install elevating devices on the sweeps at regular intervals, to raise the sweep off the seafloor. Figure 1 illustrates where the sweeps are on the trawl gear, and Figure 2 provides an example of elevating devices. In order to provide a standard that is enforceable, the regulations define minimum and maximum distances for the spacing between elevating devices, as well as a minimum clearance height for the sweep measured adjacent to the elevating device[1]. There are two different configurations which were planned for in the regulations: vessels using elevating devices that are spaced 60 ft apart would have a minimum clearance height of 3 inches (e.g., 8 inch disks or bobbins attached to 2 inch wire), and vessels using elevating devices that are spaced 90 ft apart would have a minimum clearance height of 4 inches (e.g., 10 inch bobbins or disks on 2 inch combination wire). The regulations were purposefully written to allow a degree of flexibility around these parameters, to

[1] The clearance of the sweep at the elevating device is used because it can easily be measured by vessel operators and enforcement agents. Field testing in the Bering Sea identified the relationship between clearance height at the elevating device, and the clearance of the sweep from the seafloor at its lowest point between elevating devices.

allow for wear and tear that might occur during a tow. Field testing in the Bering Sea showed that these parameters would result in a seafloor clearance across the entire length of the sweep which reduced unobserved mortality of crab.

Figure 1. Relative positions of doors, sweeps, and trawl

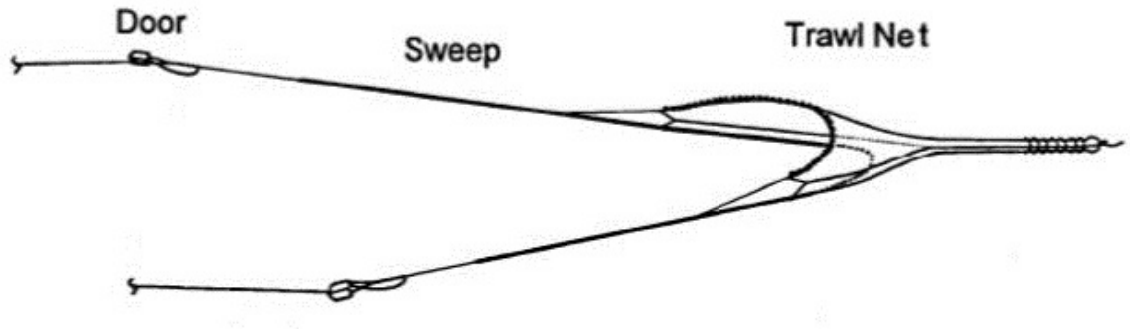


Figure 2. Example of elevating devices

In the Bering Sea, the flatfish fisheries are almost exclusively prosecuted by catcher processors using non-pelagic trawl gear. The majority of catch is harvested by vessels that are now in the Amendment 80 sector. The remainder of the catch of flatfish is primarily taken by other trawl catcher vessels. The 28 qualified Amendment 80 vessels consist of a relatively wide variety of vessels that range from 103 feet to 295 feet in length. As would be expected, the smaller vessels are relatively less productive than the larger vessels.

Most of the vessels targeting flatfish in the Bering Sea have net reels. For most dedicated flatfish Amendment 80 vessels, the total length of sweep used varies between 50 and 200 fathoms, depending on their door size and spread, and their horsepower and catch needs (see Figure 2). Bigger flatfish boats may use approximately 150 to 200 fathoms of sweep, and smaller boats use approximately 50 to 90 fathoms. Many vessels use combination rope in 90 foot segments, and the bobbins are attached between segments with coupling links.

For vessels without net reels, the trawl sweeps are wound onto the main deck winches. Vessels that put their sweeps on the main winches typically use much shorter, bare wire sweeps. Vessels using main line winches will likely use disks that are clamped on to cable to comply with the modified trawl sweep

requirement. Most of the vessels without net reels are likely to use the regulatory option that allows the use of 8-inch disks at 60-ft spacing.

What does the GOA fleet look like?

GOA non-pelagic groundfish vessels participate in various non-pelagic targets including flatfish, Pacific cod, pollock[2], and rockfish in both Central and Western GOA. Table 1 shows the number of vessels that have participated in the flatfish fishery in the GOA from 2003 through 2010. As shown in the table, including Central GOA non-pelagic fisheries other than the flatfish fishery will likely increase the number of additional vessels requiring trawl sweep modifications. For example, 10 catcher vessels participated in the Pacific cod fishery and 6 catcher vessels participated in the pollock fishery during the 2003 through 2010 period that did not participate in the flatfish fishery. The addition of other non-pelagic fisheries, as is currently define in the motion, will likely result in vessels having to meet the modification requirement that historically do not target flatfish.

In addition, requiring trawl sweep modifications for Western GOA non-pelagic fisheries would likely increase significantly the number of vessels requiring trawl sweep modifications. One of the more potentially significant expansions of the trawl sweep modification requirement would likely occur if the Western GOA Pacific cod fishery were included in the proposed action. As shown in Table 1, 41 catcher vessels targeted Western GOA Pacific cod from 2003 through 2010 that did not target flatfish in the Western GOA or the Central GOA.

As for catcher processors, since nearly all those that target flatfish in the Central GOA also target flatfish in the Western GOA, requiring modified trawl sweeps beyond Central GOA flatfish fishery would not significantly affect additional vessels. Additionally, all of the GOA trawl catcher processors targeting non-pelagic fisheries in the GOA are also Amendment 80 vessels and as such, they are likely already using the modified sweeps in the BS.

Table 1. Number of vessels in the flatfish fishery by subarea from 2003 through 2010, and number of additional vessels in other non-pelagic target fisheries that did not also fish flatfish

Area	Flatfish		Pacific cod		Rockfish		Non-pelagic pollock
	Catcher processors	Catcher vessels	Catcher processors*	Catcher vessels*	Catcher processors*	Catcher vessels*	Catcher vessels*
Central GOA	12	48	1	10	2	2	6
Western GOA	14	3	0	41	1	4	12

Source: Catch Accounting for catcher processors and Fish Tickets for catcher vessels

*Number of vessels in target fishery that did not target flatfish

GOA flatfish catcher vessels are generally smaller, lower horsepower vessels, although some larger catcher processor vessels that have used the modified sweeps in the Bering Sea also participate in the GOA flatfish fisheries. With respect to gear type, specifically flatfish gear, Alaska Groundfish Data Bank surveyed their members to describe the most relevant characteristics of the trawl gear used in the GOA bottom trawl fisheries. Alaska Fishery Science Center (AFSC) scientists compiled and summarized the data from the returned survey forms. Fourteen vessels responded to the survey, describing 22 nets used to target flatfish. The survey indicated that GOA bottom trawl gear used to target flatfish in the GOA is similar to that used in the Bering Sea. It consists of bottom trawls with footropes equipped with large diameter bobbins or disks. Most of the area affected by these trawls is covered by sweeps, long cables between the trawl doors and the net that heard flatfish into the path of the capture net. The differences in the gear used in the GOA include:

[2] Note, while the majority of vessels participating in the GOA pollock fishery use pelagic gear, there a small number of vessels that use non-pelagic gear (generally due to size or horsepower constraints of the vessel).

1. Most of the GOA trawlers reported diameters of footrope bobbins from 16 to 18 inches diameter in the center and 14-16 inches in the wings (sides of the trawl footrope) while Bering Sea trawlers use footrope bobbins and disks from 18-23 inches in diameter.
2. Most GOA sweeps used 3 inch diameter rubber disks strung over a steal cable instead of the 2 inch diameter combination rope (polyethylene-wrapped steel) used in the Bering Sea fisheries. Some GOA vessels reported using combination rope. Some also reported using widely spaced (90-120 ft) devices that raised the sweeps above the seafloor.
3. Finally, GOA vessels used shorter sweeps than those used by the larger Bering Sea trawlers. While Bering Sea sweeps cover approximately 90% of the area affected by the trawls, similar calculations for GOA gear yield 75%.

The general similarity of GOA flatfish trawl gear to that used in the Bering Sea tests indicates that the results of those tests should approximate crab mortality rates in GOA fisheries. The smaller area swept by the sweeps in the GOA indicates that the benefits of sweep modifications would be somewhat smaller than those for Bering Sea fisheries, but still substantial

Since the research on modified gear has been limited to flatfish vessels only, little is known about whether modified sweeps would work in the other non-pelagic GOA fisheries. Sweep lengths for other non-pelagic fisheries may be less than is used in the flatfish target fisheries. Vessels also tend to use shorter sweeps in rough bottom areas where some of these other non-pelagic trawl target fisheries occur. In the rockfish fishery, in recent years many of the vessels are employing pelagic gear. For those rockfish vessel that still use bottom gear, many of these nets are equipped with so-called “tire gear,” in which automobile tires are attached to the footrope to facilitate towing over rough substrates (NMFS, 2010). It is likely that elevated disks in fisheries with a rough bottom habitat would be less effective and require a high level of maintenance to replace continually eroded/destroyed disks. In addition, the smaller sweeps employed in other non-pelagic fisheries results in less area swept and therefore the benefit of modified sweeps in reducing crab morality would be less in these fisheries.

Is the trawl sweep modification effective at reducing crab mortality in the GOA?

The trawl sweep modification has been tested to be effective in the Bering Sea flatfish trawl fishery in reducing trawl sweep impact effects on C. bairdi, C. opilio, and red king crabs by reducing the unobserved mortality of these species. Additionally, the trawl sweep modification has proven effective on the Bering Sea shelf at reducing effects on sea whips (a long-lived species of primary concern), and did not substantially reduce catches of target flatfish. Test for reduced impacts on basketstars, sponges, and polychaete siphons were positive in direction, but non-significant.

The relevance of that study to crabs in the GOA depends largely on the similarities in sediment type in the Bering Sea and GOA, and between the bottom trawl gear tested in the Bering Sea and those used in the GOA. The sediment in the Bering Sea where the flatfish fishery occurs consists mainly of sand, muddy sand, or gravelly muddy sand (NMFS 2009), and such was the sediment in the areas of the research study. Sediment in the GOA flatfish fisheries is variable, with similar sand and gravelly sand substrates, but also gravelly mud and silty clay areas. GOA Pacific cod preferred substrate is soft sediment, from mud and clay to sand, while rockfish preferred substrate is relatively rough, variously defined as hard, steep, rocky or uneven bottom on the banks of the outer continental shelf (NPFMC, 2010).

Given that crab bycatch by non-pelagic vessels differs across target fisheries and areas, a trawl sweep modification requirement for non-pelagic gear will likely have varying degrees of success at reducing crab mortality. As shown in Table 2, the flatfish fisheries account for the largest portion of the non-pelagic Tanner crab bycatch, averaging 90 percent of the bycatch from 2003 through 2010. By

comparison, other non-pelagic fisheries, which include Pacific cod, rockfish, and bottom pollock account for only 6 percent of the Tanner crab bycatch. Bycatch at the area level shows that the Central GOA (area 620 and 630 combined) accounts for the largest share of Tanner crab bycatch, averaging 92 percent from 2003 through 2010, while in the Western GOA bycatch is significantly lower with an average of 8 percent from 2003 through 2010. Overall, the flatfish fisheries in the Central GOA appears to the primary contributor of Tanner crab bycatch, while other non-pelagic fisheries in the Central GOA and Western GOA account for only a modest amount of Tanner crab bycatch. In addition, the bycatch data suggest that the flatfish targets tend to occur on bottom types which are preferred crab habitat.

Table 2. Bycatch of C. bairdi Tanner crabs in Federal non-pelagic groundfish fisheries, in reporting areas 610, 620, and 630, by target fishery, 2003-2010

Subarea	Target Fishery		2003	2004	2005	2006	2007	2008	2009	2010
610	Flatfish	Arrowtooth Flounder	970	247	1,985	1,566	1,417	685	1,004	0
		Flathead Sole	152	5,199	31,416	2,414	279	0	35	993
		Shallow Water Flatfish	535	117	58	340	221		0	
		Rex Sole	4,465	3,142	63	2,615	477	26	54	32
	Other non-pelagic	Pacific Cod	695	267	1,045	209	3,967	5,130	917	1,750
		Pollock*	2	17	0	11	32	945	50	25
		Rockfish	7	0	0	129	81	0	34	0
610 Total			**6,826**	**8,989**	**34,567**	**7,285**	**6,474**	**6,786**	**2,094**	**2,799**
620	Flatfish	Arrowtooth Flounder	7,255	252	20	2,752	2,575	582	1,839	2,025
		Flathead Sole	883	65	0			112	0	757
		Shallow Water Flatfish	2,838	1,077	854	2,017	13,010	2,242	9,079	2,339
		Rex Sole	12,226	1,773	3,211	33,503	19,817	26,619	35,254	10,905
	Other non-pelagic	Pacific Cod	34	48	0	6	286	4,264	22	174
		Pollock*	0	670	0	26,816	2,874	19	3,485	31
		Rockfish	0	0	0	0	21	1	0	100
620 Total			**23,237**	**3,886**	**4,085**	**65,094**	**38,582**	**33,840**	**49,678**	**16,332**
630	Flatfish	Arrowtooth Flounder	20,934	33,012	66,925	84,108	40,523	33,716	37,884	45,160
		Deep Water Flatfish	0	0			0			0
		Flathead Sole	16,601	2,249	12,540	23,470	24	6,397	7,647	4,747
		Shallow Water Flatfish	55,780	7,506	5,091	31,098	65,687	20,456	21,177	19,393
		Rex Sole	17,241	4,115	1,187	37,410	24,979	21,373	105,058	3,330
	Other non-pelagic	Pacific Cod	1,498	846	270	526	11,878	9,282	1,434	0
		Pollock*	3	536	5	57,178	16,552	255	3,097	51
		Rockfish	171	1,517	1,750	830	57	64	195	0
630 Total			**112,228**	**49,782**	**87,767**	**234,620**	**159,700**	**91,544**	**176,492**	**72,681**
Grand Total			**142,291**	**62,656**	**126,419**	**307,000**	**204,756**	**132,169**	**228,263**	**91,812**

Source: Catch Accounting

*Caught with non-pelagic gear

One explanation for the variability of crab bycatch across the different areas and target fisheries could be the geographic overlap between the different target fisheries and areas of Tanner crab abundance. As shown in Figures 3 and 4, most of the Tanner crab abundance is located in the near shore portion of South East Kodiak Island (Central GOA) and in the near shore portion of the Alaska Peninsula (Western GOA). As shown in Figure 5, the primary fisheries occurring in close proximity to Kodiak Island are the arrowtooth flounder, shallow-water flatfish, and the Pacific cod fisheries. The rockfish fishery tends to be located in deeper waters of the GOA along the shelf edge. As such, the arrowtooth and shallow-water flatfish have higher Tanner crab bycatch which is supported in Table 2, while the rockfish fishery has lower Tanner crab bycatch. As for Pacific cod, data in Table 2 suggests a lower bycatch of Tanner crab despite being in close proximity to the Tanner crab grounds. One explanation for the lower bycatch numbers could be because the Pacific cod fishery tends to be limited to a few very specific locations that have low Tanner crab abundance.

Figure 3. Tanner crab distribution of Kodiak from the 2009 trawl surveys

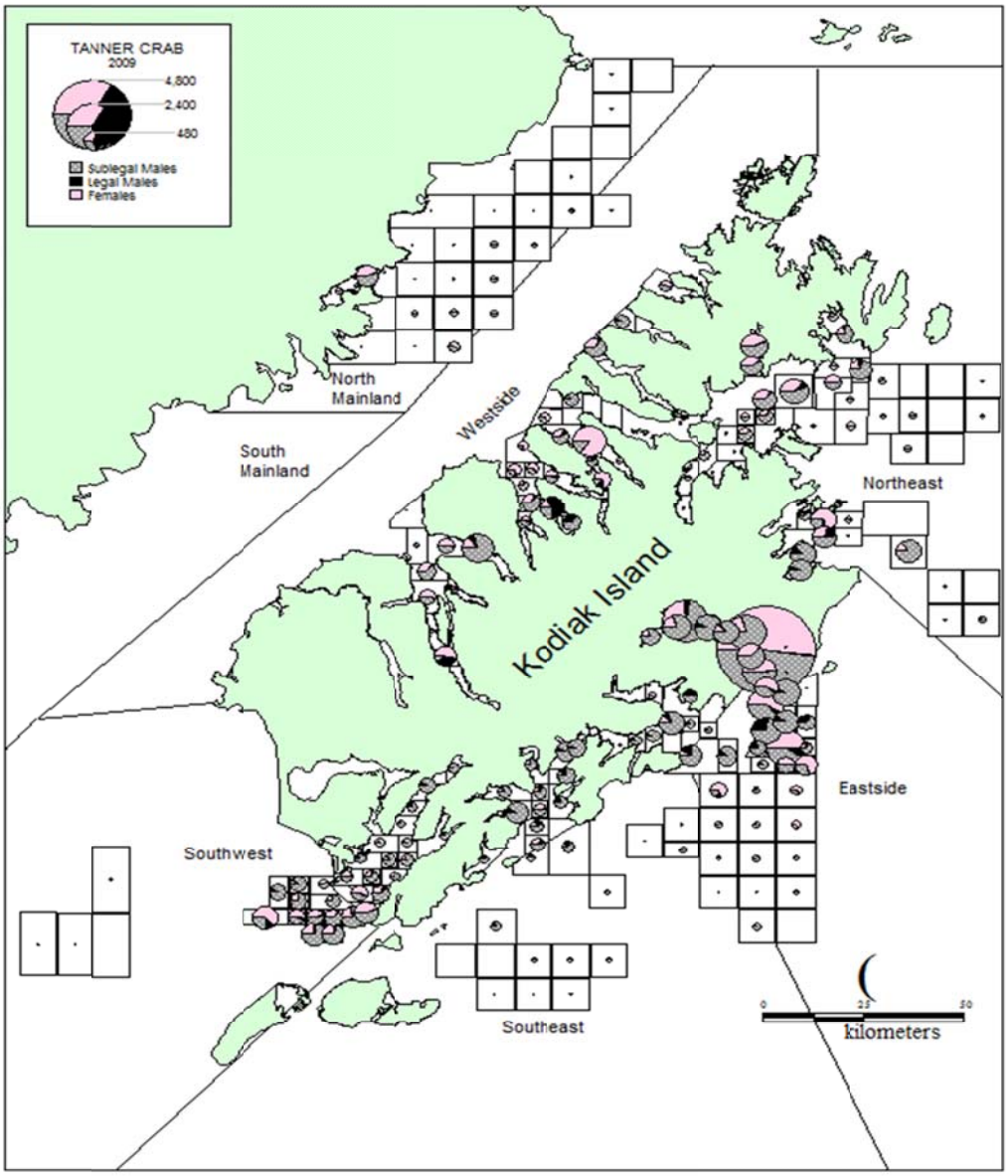


Figure 4. Tanner crab distribution of Alaska Peninsula from the 2009 trawl surveys

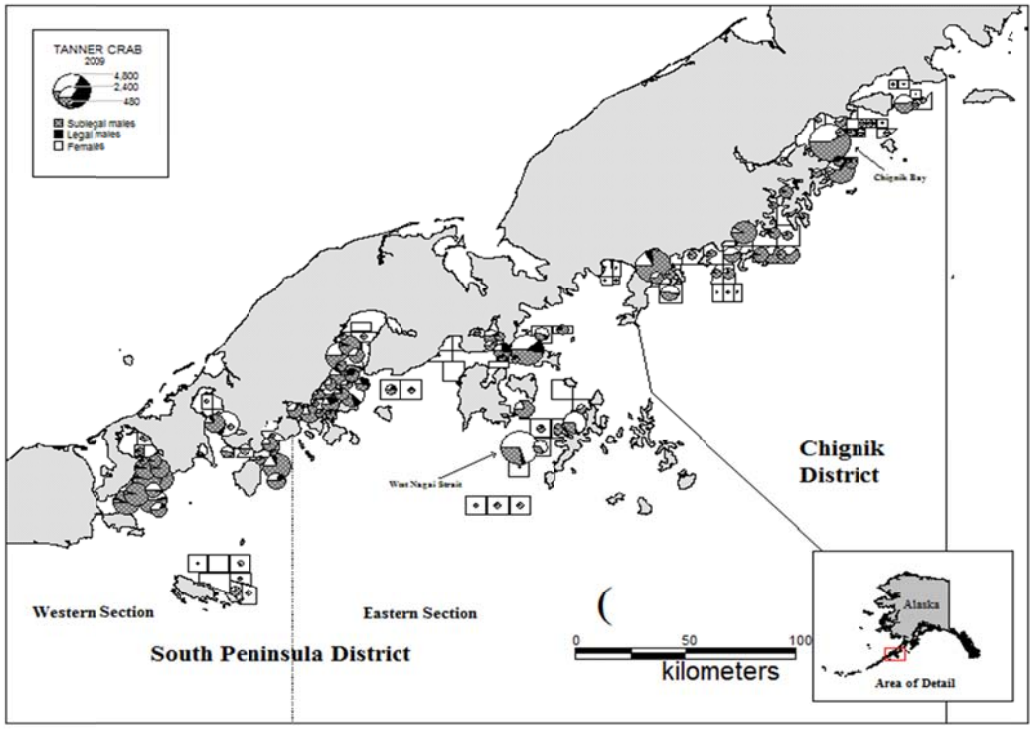
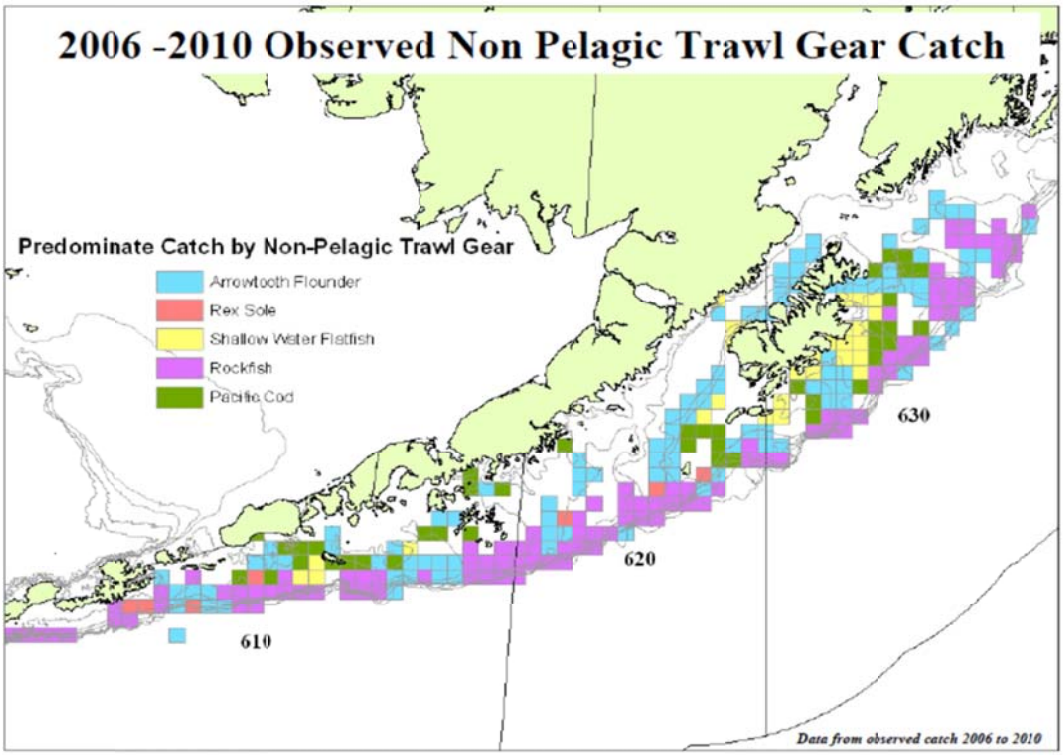


Figure 5. Observed non-pelagic trawl gear catch from 2006 through 2010 shows observed non-pelagic trawl fishery catch from 2006 through 2010 for the Western and Central GOA



Proposed Research

Research and field testing is needed to ensure that the BS tests and regulation requirements are applicable in the GOA. Verification and comparative work in the GOA will focus on disc or bobbin (sweep elevation device) height and spacing (between elevating devices) so that the same degree of elevation from the seafloor (approximately 3 inches) is achieved given the specifics of the GOA flatfish fisheries. Factors affecting whether sufficient lift can be attained in the GOA flatfish fisheries as compared to the BS include: towing power and/or speed of GOA vessels, styles and/or sizes of trawl doors, rigging of trawl nets, bridle and sweep materials (e.g. cookie sweeps rather than combination rope), and sediments and bathymetry of the GOA flatfish fishing grounds as compared to the Bering Sea grounds. The starting point for this research should be the BS spacing and disc height requirements as described in the sweep modification regulations (e.g., the equivalent of 10 inch elevating devices for 2 inch combination rope sweeps and 90 foot spacing. This will help show if the GOA physical environment and/or vessel and gear differences affect sweep lift, compared to the Bering Sea.

From a practical perspective, using the BS spacing and elevation requirements would also help to avoid potentially unnecessary costs for vessels that have already made investments in meeting the sweep modifications regulations that are in place for the Bering Sea flatfish industry. The spacing that was implemented in the BS reflects what was feasible given the net reel capacity of the larger Bering Sea flatfish vessels. If the testing in the GOA shows that significantly closer spacing is required for the GOA flatfish fisheries, knowing this from the outset will be important in terms of consideration of costs and benefits of implementing a sweep modification requirement in the GOA for the different GOA flatfish dependent fishermen.

In January 2011, captains of both the GOA catcher vessel fleet and the head and gut catcher processor fleet met to discuss the modified trawl sweep implementation in the GOA. During the meetings, there was discussion concerning the measuring of the modified trawl sweeps for enforcement purposes. Height measurements of GOA cookie gear would be the same as combination wire, but from the high point of the cookie adjacent to elevating device. The use of a specific length of rope to measure spacing lengths could be used in the GOA much like what will employed in the BS. In addition, measuring from the aft reel will be more problematic at sea, thus it was thought that verifying height and spacing at the dockside would be easier. Like the BS, 30 foot minimum spacing would likely work in the GOA. Summer testing would require 1 to 2 vessels of various horsepower and size to test elevated devices using 90 foot sections. It was also noted that it would be best to test the modified trawl sweeps in less intense fisheries, like shallow water flatfish and arrowtooth. For Pacific cod, testing can be performed in the Central GOA rockfish program using Pacific cod catch quota. One concern was that elevated disks are likely to be less effective as well as eroded/destroyed in rough bottom fisheries (rockfish, Pacific cod, and rex sole), so testing of elevated devices will be needed to determine the viability of these devices.

Proposed steps for verification of lift achievement and testing plan

As noted above, the testing plan builds on work done in the BS flatfish fishery. Many scientific questions would need to be answered first before applying the modified sweeps to other target fisheries. Some examples include the impact on catch per unit effort if the elevation devices are required on sweeps, sweep characteristics for the different targets to measure benefit to crabs, and wear and tear on the gear in rougher bottom types. Utility or practicality of the gear for other fisheries has not been studied.

January 2011: Meeting with fishermen to gather testing parameters for different vessel classes and sweep modification designs. Vessel owners / operators will give their perspective of the practicability of different sweep modification designs for their individual vessel platform and net reels.

Spring/summer 2011: When flatfish fishing commences in 2011, a field technician with experience in tilt sensor placements on sweeps will go out on three GOA flatfish vessels of different sizes. The goal of this "ride along" cruise under regular commercial fishing conditions will be to place tilt sensors between the elevating devices installed on a section of modified sweeps that is added to each vessel for each cruise. The initial configuration of modified sweep gear will comply with the current Bering Sea regulations. The vessel size classes of interest for this work should be smaller GOA flatfish catcher vessels (range of horsepower < 800), larger GOA flatfish catcher vessels (horsepower > 800), and a Bering Sea flatfish catcher processor that fishes GOA flatfish (range of horsepower : 1,200 to 3,000). This work will establish whether the current Bering Sea standards for modified sweeps achieve the same lift at the midpoints of the sweeps as was seen in the Bering Sea.

Follow-up cruise if adjustments are needed: Once analysis of the tilt sensor data from the first fieldwork is complete, adjustments to spacing or height of elevating devices, if deemed necessary, can be made on the section of modified sweeps used in the first stage of verification work. This may include reducing the spacing to 60 feet or increasing the height of elevating devices to 11 inches. The second stage of testing would confirm whether the adjustments were sufficient to achieve the desired elevation. Another round of tilt sensor testing would be done to verify that the new parameters achieve the desired amount of lift between elevating devices.

Fleet implementation evaluation: Once the field testing has come up with a set of parameters that the testing shows will achieve the necessary lift, fishermen will need to do some practicability evaluation. For this, a full set of sweeps that meet the GOA height and spacing parameters would be needed. This will allow fishermen to evaluate the differences in setting and retrieving the trawl gear with the modified sweeps as well as seeing if their current net reel capacity is sufficient for loading a full set of modified sweeps meeting the GOA parameters. Conducting a field demonstration for enforcement practicality issues with NMFS enforcement and NOAA GC would also be worthwhile at that point so that enforcement concerns can be addressed early on in the pre-implementation process.

The Central GOA trawl industry in partnership with AFSC scientists would share in the costs of the research for implementing sweeps in flatfish fisheries. The trawl industry would provide fishing platforms and gear as available at no cost to scientific staff from RACE. RACE will analyze the tilt sensor data and provide project staff for the collection of data and analyses the data for achieving the desired crab mortality reduction benefits. **Funding and the timeline for research for implementing sweeps in other non-pelagic fisheries have not been addressed.**

Council action

- None required (Council motion stands): implement sweep modification for non-pelagic trawl fisheries in the Central GOA
- Options (may be combined):
    - a) limit amendment to just flatfish fisheries;
    - b) limit amendment to flatfish, Pacific cod, and pollock (remove rockfish)
    - c) limit geographic scope of amendment to areas of Tanner crab abundance around Kodiak included in Council's October 2010 Tanner crab analysis (Marmot, Chiniak, and statistical area 525702 (see Figure 6 and Table 3).
    - d) expand to WGOA;
    - e) bifurcate amendment (e.g., do flatfish first and follow with other non-pelagic trawl targets)

Figure 6. Areas of Tanner crab bycatch measures from October 2010 Council action

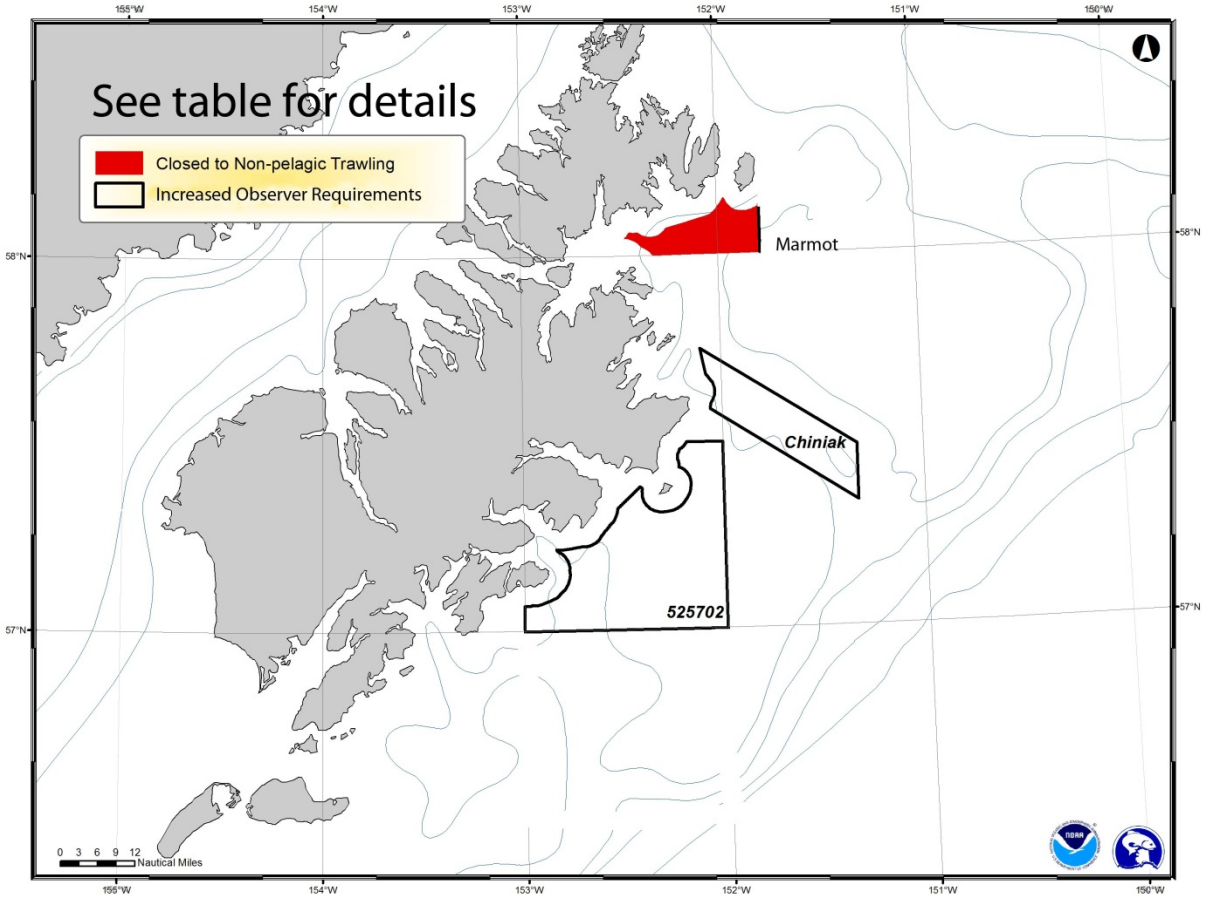


Table 3. Tanner crab bycatch measures from October 2010 Council action

Area	Trawl	Pot
Marmot Bay	Closed (vessels using pelagic trawl gear to fish for pollock are exempt)	Closed to pot gear unless 30% observer coverage
Chiniak Gully	Closed to non-pelagic trawl gear unless 100% observer coverage	
ADFG statistical area 525702		

References

National Marine Fisheries Service. 2009. Proposed Amendment 94 to the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area to Require Trawl Sweep Modification in the Bering Sea Flatfish Fishery, Establish a Modified Gear Trawl Zone, and Revise Boundaries of the Northern Bering Sea Research Area and Saint Matthew Island Habitat Conservation Area: Environmental Assessment/Regulatory Impact Review/ Initial Regulatory Flexibility Analysis. National Marine Fisheries Service, Juneau, AK. October 2009.

North Pacific Fishery Management Council. 2010. Stock Assessment and Fishery Evaluation (SAFE) Report for the Groundfish Resources of the Gulf of Alaska. Compiled by the Plan Team for the Groundfish Fisheries of the Gulf of Alaska. NPFMC, 605 West 4th Avenue, Anchorage, AK. 99501.