Contents

Introduction

As has been noted at previous meetings, options for minimizing the adverse effects of fishing on EFH include area closures, gear restrictions/modifications, and effort reductions. Given varying degrees of confidence in the underlying data in certain locations as compared to others, gear modifications vs. area closures to certain gear types may be useful for achieving management goals.

Gear modification options proposed during EFH Omnibus 2 process

During their June 6, 2010 meeting, the habitat committee proposed that management options for habitat closed areas include "gear modifications such as reduced rockhopper size and shortened legs for trawl vessels, and appropriate measures for other gears". Both the PDT and AP discussed these options at their July and August meetings, and the PDT has done some preliminary work on fishing distributions in the GOM roller gear restricted area in relation to boulder ridges and high $Z\infty$ areas.

PDT discussion of gear modifications (27 July 2010)

The PDT discussed two specific modifications for trawl gears, roller gear size limits and ground cable size limits. There are two mechanisms via which a change in roller gear size might affect seabed impact. First, larger or smaller rollers are likely to alter the direct seabed contact of the gear, which could change the quality of the gear impact on structural seabed features[1]. These issues were discussed earlier on in the development of SASI specific to the vulnerability assessment, and the team was reminded that there is considerable uncertainty amongst gear technologists in terms of how different gear configurations contact the seafloor (which is why the vulnerability assessment was not disaggregated by trawl configuration or trawl component).

[1] For example, the team discussed that the middle of the sweep has different contact with the seabed than the wings, and that rollers may behave differently depending on their position along the sweep. Specifically, due to the curvature of the sweep during fishing, rollers in the middle of the sweep will be more widely spaced, while they will be more closely spaced on either end of the sweep. In terms of rollers of varying sizes, it was noted that the rollers' effective weight in water is less than 100% of their weight at the surface. Also, wider rollers may better distribute the weight of the gear along the seabed, such that roller size could influence the penetration of the gear on the seabed and thus seabed impact.

Another mechanism via which seabed impact could be reduced is a roller gear restriction. Reduced seabed impact via this mechanism relies on the vulnerability assessment finding that adverse effects are greater on larger substrate size classes due to the structural features inferred to those substrates, and also on the assumption that restricting roller gear use to smaller sizes only would limit a vessel's ability to tow gear over those larger substrates. This would presumably avoid seabed contact in areas with larger grain sizes and redistribute effort into areas where the same amount of area swept would produce less seabed impact.

In order to investigate whether the distribution of fishing on certain substrates is influenced by restrictions on roller gear size, Chad Demarest examined the size frequency distribution of rollers on various trawl gear types (generic otter trawl, shrimp trawl, squid trawl) and their distribution relative to high Z_∞ cells inside and outside of the inshore GOM 12 in roller gear restricted area.

He found that a distribution of roller sizes were used for all three gear types, with successively smaller sizes reported from generic trawl to shrimp trawl to squid trawl (Table 1).

Table 1 – Mean ground gear diameter and number of observed tows by SASI gear type

	Mean sweep_dia	N
Otter_trawl	11.2	34,902
Shrimp_trawl	10.2	149
Squid_trawl	4.3	1,481

To test whether roller gear size varies by habitat vulnerability, he compared roller gear diameter in inches for tows conducted in high Z_∞ vs. low Z_∞ cells. These comparisons were only made for generic otter trawl and shrimp gear, as there were no observed squid trawl tows in high Z_∞ cells. Data were disaggregated into two groups representing tows occurring inside grid cells with high Z_∞ (>51.415, the lowest mean Z_∞ the seven grounfish LISA clusters) and low Z_∞ (<51.416). A two-sample independent t-test was performed, testing the differences in means between these two groups. The null hypothesis is that the mean difference is zero.

For the generic otter trawl gear type (Table 5) there was a significant difference in mean sweep diameter between the low and high Z_∞ groups at the 0.01 level, implying that vessels do tow with larger diameter roller gear in areas of high Z_∞ accumulation. For the shrimp trawl (Table 6), the difference in mean sweep diameter is significant at the 0.10 level but not the 0.05 level. I conclude that this difference is not significant and that vessels using shrimp gear most likely use the same size rollers inside and outside of high Z_∞ cells, but others may reasonably choose to disagree. There were no tows observed for squid gear in high Z_∞ grid cells, so no comparison could be made.

Variance for shrimp gear sweep diameter, as previously noted, is zero. Between-group variance was unequal for both the generic and shrimp trawl categories and the unequal variance statistic (Satterthwaite) is used for significance determination. It should be noted that the normalcy of residuals assumption is violated in both cases, but in both cases n is sufficiently large and it is unlikely that this violation will influence the t-statistic.

In the discussion, he noted that one may speculate that, based on the results of the Vulnerability Assessment, areas of high Z_∞ accumulation are more likely to contain high-relief substrates and fisherman chose to use larger diameter ground gear in such areas to minimize interactions between the bottom and their gear. Therefore it is possible that a reduction in roller gear size will result in changes in fishing locations such that high-relief substrates become less practicable for fishing. Countervailing this is the potential for increased damage to bottom habitats due to fishing gear interactions if fishermen do not alter their behavior to avoid high-relief areas. Additional factors such as gear selectivity for target species are not considered here, but may be important for protecting habitat as regulations that render fishing less efficient will likely result in increased bottom contact time. As with area closure measures, the overall effect on habitat depends entirely on the slope of the relevant impact and catch curves.

Table 2 – Two-sample independent t-test for sweepdia in high and low Z_∞ grid cells, generic otter trawl gear

		Variable:		(SWEEPDIA)		
Group	**N**	**Mean**	**Std Dev**	**Std Err**	**Minimum**	**Maximum**
high	4127	14.205	6.524	0.1016	2	24
low	29169	10.8531	6.503	0.0381	2	36
Diff (1-2)		3.3519	6.5056	0.1082		

Method	**Variances**	**DF**	**t-value**	**PR > |t|**
Satterthwaite	Unequal	5352.6	30.91	**<.0001**

Table 3 - Two-sample independent t-test for sweepdia in high and low Z_∞ grid cells, shrimp trawl gear

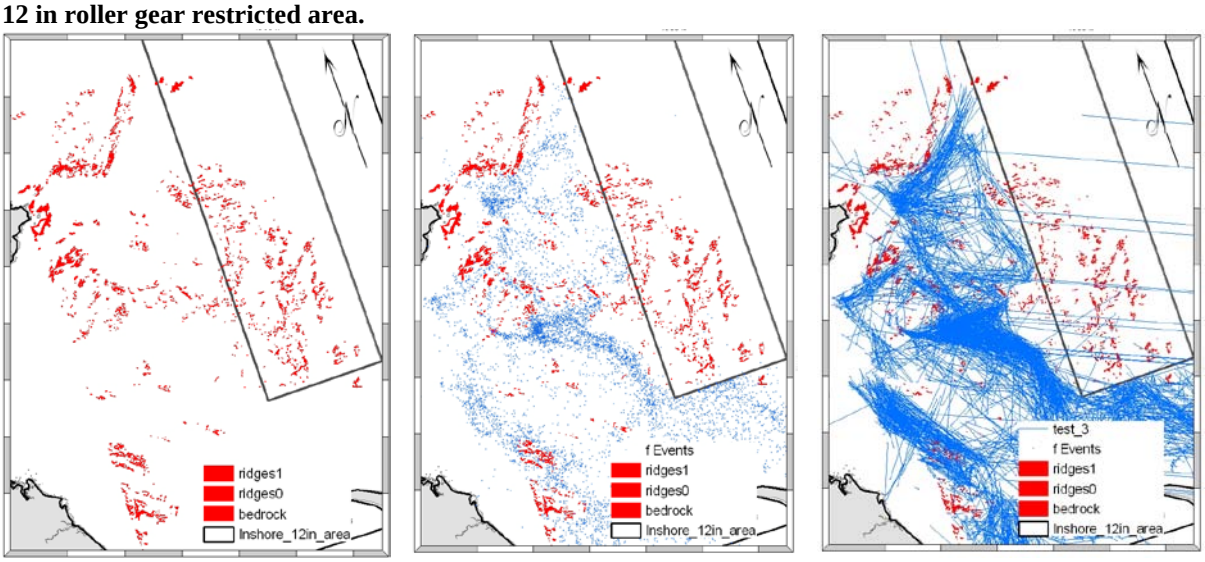
		Variable:		(SWEEPDIA)		
Group	**N**	**Mean**	**Std Dev**	**Std Err**	**Minimum**	**Maximum**
high	67	10.7164	3.1421	0.3839	5	16
low	82	9.7439	2.9806	0.3292	2	16
Diff (1-2)		0.9725	3.0542	0.503		

Method	**Variances**	**DF**	**t-value**	**PR > |t|**
Satterthwaite	Unequal	137.96	1.92	**0.0565**

The team discussed that there would need to be a clear basis for any gear modification measures enacted, and that there would need to be evidence to support that such a restriction would be effective in terms of reducing adverse effects. A team member asked why the 12" gear size was selected for the inshore GOM area, and wondered whether another size might have a larger influence on fishing behavior. It was also discussed that by enacting restrictions in one area, another area might experience increased fishing effort and thus increased adverse effects. Also, it was noted that factors other than large-sized substrates could influence the decision to use larger sized roller gear, for example if the fishing grounds had large sand waves, or if the vessel was targeting a particular species (e.g. haddock, which are generally not directly on the seabed but slightly above it).

Two suggestions for further analysis included: (1) Overlay mean roller gear sizes with bathymetry to determine reasons for larger gear in certain areas. (2) Overlay tow-by-tow fishing effort data from the observer program with highly resolved boulder reef locations (WGOM/SBNMS area), to try and replicate the effects observed by Bellman et al 2005[2] (i.e. changing fishing behavior due to gear size restrictions). Maps of observed trawl tow start and end points and inferred straight line tow tracks with respect to boulder ridge data are shown below (Figure 1).

Figure 1 – Boulder ridges; tow start and end points of trawl tows in relation to boulder ridges; inferred straight line tow tracks in relation to boulder ridges. Note that the entire map is within the 12 in roller gear restricted area.



The group also discussed ground cable length restrictions. The purpose of ground cables is to direct fish into the net, and the length of the cables can affect the size of the

[2] Bellman, M. A., S. A. Heppell, et al. (2005). "Evaluation of a US west coast groundfish habitat conservation regulation via analysis of spatial and temporal patterns of trawl fishing effort." Can. J. Fish. Aquat. Sci. **62**: 2886-2900.

fish caught based on how they are guided into the mouth of the trawl. However, it was noted that the relationship between cable length and herding ability is not very well researched. Thus, although reducing ground cable length would reduce area swept and thereby reduce impacts to EFH, length limits could affect fish catches and thus have unintended consequences. Ground cable length is also related to fish size, and depth.

Finally, although they are very infrequently used for bottom trawls, the team briefly discussed how catch and habitat impact might change with the use of semi-pelagic trawl doors. Although unlikely to affect this management action, the use of semi-pelagic doors as a mechanism for reducing environmental impacts of fishing might be considered in the future.

Advisory panel discussion of gear modifications (12 August 2010)

Ms. Jordan noted that due to the combination of 12 inch roller gear restriction in the inshore GOM and closed areas throughout the GOM, fishing in the GOM is now highly localized. She emphasized that we should be looking at data from the 12 inch roller gear restriction area to evaluate the impacts of this measure and the potential implications for any new gear restriction measures.

Mr. Taylor stated his preference for a habitat protection strategy would be to fully protect vulnerable areas with closures, rather than through the use of gear restrictions, which might or might not be effective in preventing fishing on vulnerable substrates.

Mr. Williamson stated his understanding was that in configuring a trawl vessel for fishing, owners make a tradeoff between horsepower and ground gear or cables. Ms. Jordan stated that it was not clear what the goals are of the restrictions – to exclude larger vessels? Mr. Taylor reiterated Mr. Williamson's earlier statement, acknowledging the wide variety of risk vs. return decisions made as skippers choose their gear. If the goal is to identify and protect particular areas, he stated that this would best be accomplished via closures, not using gear restrictions. Ms. Raymond followed up stating that it is more honest to say you can't fish an area at all then to say you can fish here with a gear that doesn't catch fish.

Some impacts of the current area closures (both habitat-related and not) were discussed. These include: the most productive areas are currently closed; fishing occurs in less productive areas and catch rates decline; and fishing is highly concentrated. The group discussed that current management (i.e. sectors) has further reduced swept area, even as compared to last year, and that capacity in groundfish fishery is being reduced dramatically. It was noted that managers should allow people to use the gear types that work best for them so that they can fish most efficiently.

Mr. Minkiewicz followed up to this last comment, noting that to reduce impact according to SASI you reduce area swept. He referenced the example of the ban on

'street sweeper' gear, which was prohibited because it increased the catch of fish. If efficiency is the goal, then these types of restrictions are counter to what we are trying to do with the amendment. The question then becomes, 'Are there gear modifications that would allow for more efficient fishing and thus reduce area swept overall'?

Returning to the comment on sectors, Mr. Wallace emphasized that the whole philosophy of fishing changes under sectors – the goal under sector management is to get fish in your quota and then get off the water. Following on this, Mr. Williamson stated that the Council should be creating incentives for more efficient gear, and that these types of options do not do that. He assumed that captains are already zeroing in on optimum gear design for their type of fishing.

To further the discussion, the Chair asked whether all gear restrictions should be eliminated in favor of closures only. In response, Mr. Williamson stated that there are two ways to use habitat closures. (1) Close sensitive areas to all gears. (2) For sensitive but productive areas, allow reduced impact gears only (e.g. sweep-less trawls). He stated that there may be areas in which people would be willing to make such tradeoffs (i.e. to use perhaps less efficient but reduced impact gear, rather than not fishing in the area altogether). He stated that neither of these two gear restrictions will likely produce a positive outcome in terms of habitat.

Mr. Wallace asked rhetorically what is 'bad' about certain gears – large roller gear, long sweeps, etc. He asked if the group wished to make a statement of about appropriate types of sweeps, roller gear etc. He noted that quotas are better than days at sea in terms of improving efficiency, and that making vessels less efficient is financially inefficient. Mr. Taylor asked whether the goal was to protect habitats or to improve fishery management (efficiency?).

Following on the discussion of efficiency, Ms. Raymond suggested opening the WGOM habitat closed area to shrimp trawling, but it was questioned whether the motion was out of order and then the motion was tabled by the maker.

Ms. Jordan suggested that there should be no roller gear or ground cable size limits. Ms. Raymond stated her opposition to the motion, noting that the alternative might be worse (i.e. additional habitat closures). She noted that she could support the motion if the group reviewed the June Committee motions. The group discussed that it would be important to review candidate management areas individually to determine what gears are currently used and how their use might be optimized. The Chair noted his expectation that the AP would eventually be given the opportunity to weigh in on measures for specific areas. This second motion was then withdrawn by its maker.

Ms. Raymond recommended that the AP endorse as the preferred alternative the no closure alternative suggested by the Committee in June (Part 3 of 6/10/10 Committee

Motion 1 and Part 4 of 6/10/10 Committee Motion 2, i.e. no closure alternative to reduce Z by maximizing CPUE). This motion carried on a show of hands (5/1/0).

Gear modification regulations at the PFMC

The Pacific Fishery Management Council (PFMC) uses trawl gear restrictions in their groundfish FMP. There are four types of permit holders in the fishery: 1) Limited entry; 2) Open access for fishermen that target groundfish without limited entry permits, as well as those that aren't targeting but incidentally catch groundfish; 3) Recreational; and 4) Tribal. Trawl gear may not generally be used in open access for groundfish, but those fishing for shrimp, halibut, ridgeback prawn, and sea cucumbers are exempt. Limited entry Quota Share and Quota Pound allocations were developed based on estimates from 1994-2003 takes.

Regulations include quotas, trip and landing limits, area restrictions, seasonal closures and gear restrictions. Depth-based gear-specific restrictions (small footropes at a maximum diameter of 8 inches, depths vary according to area) have helped deter fishing on high relief rocky bottoms where rockfish species (which have been depleted due to a previously aggressive harvest policy) are most abundant. Chafing gear is also restricted if using small footrope configuration to reduce incentives to fish on high relief areas.

Hannah (2003) reviewed the efficacy of these gear restrictions, enacted in 2000, for meeting management goals. The strategies of the regulations as stated in Hannah (2003) was to rebuild shelf rockfish stocks using gear restrictions (the 8" max diameter footrope) and restrict use of chafing gear to dissuade fishing on high-relief rocky bottoms were rockfish were most abundant. Higher catch limits were allowed for continental slope species (like Dover sole, sablefish, and thornyheads) with larger roller gear, and other rockfish species taken with midwater trawls also had higher trawl limits. Hannah stated that in a "practical sense…all financial incentives for using such gear in areas with abundant rockfish were eliminated".

Data have suggested that the new gear restrictions and regulations are having the desired effect on the distribution of trawl effort, but also that catch limits could have an equal or greater bearing on fishing effort. Specifically, reduced limits alone (before gear restrictions) reduced the effort (number of tows per vessel) in "prime trawlable rockfish habitat" from 30.8-33.9% in 1992-1995 to 19% in 1999. After catch limits were increased, in 2001 (right after gear restrictions were implemented), there was increased trawling effort on rockfish areas, however effort did not reach the 1999 levels.

These results were corroborated by a spatial analysis conducted by Bellman et al. (2005). They evaluated the extent to which trawl tow start locations overlapped with various habitat types, mapped as rock, gravel, sand-gravel, sand, sand-mud, or mud-dominated. For a subset of reference sites, trawl towlines were calculated using haulback locations taken manually from logbook records. Following the 2000 footrope restriction, spatial

shifts in effort away from rock-dominated habitats were observed. This decrease in fishing on rock habitats was against a background of generally decreasing trawl fishing effort off the Oregon coast between 1997 and 2002. However, it was not possible in the study to distinguish between the effects of the footrope restriction and the effects of changes in trip limits on trawling location, and the authors concurred with Hannah (2003) that both sets of management measures influenced fishermen's choice of tow locations.