May 25, 2012
Enclosure (5) to Groundfish PDT report dated July 27, 2012

Enclosure (5)
Full Retention

Regulatory Restrictions

There are two primary ways that regulations can prevent full retention of fish that are caught: through the use of size limits (which can include minimum size limits or slot limits that restrict landing to a range of sizes) and through the use of possession limits.

The Northeast Multispecies FMP specifies minimum size limits for cod, haddock, yellowtail flounder, winter flounder, witch flounder, plaice, redfish, pollock, and halibut. Minimum size limits are not specified for white hake, wolffish, ocean pout, or windowpane flounder (three of these species cannot be landed under present regulations). Common pool vessels are subject to possession limits for several stocks. The FMP can modify these minimum size limits and possession limits through a framework adjustment or an amendment. The Northeast Multispecies FMP cannot require full retention of species managed in other FMPs (monkfish, skates, dogfish, etc.).

When minimum size limits were adopted in the original FMP (1986), it was the principal management measure in the management program. It was intended to direct the fishery away from immature fish and focus the catch on fish that have already contributed to the spawning potential of the stocks (NEFMC 1985). The appropriate minimum size was established based on the average length of fish at sexual maturity “and other factors which may include commercial considerations.” These other factors included the mixed nature of the fishery, the mortality of sub-legal fish caught in the net and impacts on discards. Minimum sizes adopted included 17 inches for cod, haddock, and pollock, 14 inches for witch flounder, 12 inches for yellowtail flounder and plaice, and 11 inches for winter flounder. Minimum sizes for cod, haddock, pollock, witch flounder, and winter flounder were scheduled to increase in year 2 of the plan. This schedule was later modified. The link between minimum fish size and mesh selectivity was recognized, and planned increases in the minimum mesh size were included. These mesh size increases were later delayed.

Amendment 5, in addition to adopting a permit moratorium and effort controls, made a subtle change in the use of minimum mesh sizes and minimum fish sizes. Vessels retaining more than 500 pounds of groundfish were required to fish under an appropriate mesh regulation for the area fished. The minimum fish sizes for regulated species were supposed to be set at the length where 25 percent of the fish at minimum size would be retained, with the exception of winter flounder.

Over time, the mesh regulations were modified without corresponding changes to the minimum size requirements. While the regulations still include a provision that minimum sizes should be set at the length at which 25 percent of the regulated species would be retained, this has not been used to adjust minimum sizes since Amendment 7. For example, in Amendment 13 (2004) mesh changes were used to avoid additional DAS reductions and minimum sizes were not increased at the same time.

Possession limits no longer apply to sector vessels for allocated groundfish[1], but they are still used for common pool vessels fishing under effort controls. While this measure may not be needed as a mortality control since the common pool is now subject to quotas, it does serve to slow the catch of these stocks and provides extended opportunities for common pool fishermen.

Biological Considerations

The combination of minimum size and mesh increases has affected the size of fish captured. The selectivity of several multispecies stocks has shifted to older fish as these regulations changed over time, generally consistent with the adoption of increased mesh sizes and minimum sizes (see, for example, stock assessments for GB cod, GOM cod, GB haddock, GOM haddock, and plaice). In at least one assessment (GOM cod) the shift in selectivity is partially credited with helping the stock sustain high fishing mortality rates over time. These shifts in selectivity have changed (increased) the yield-per-recruit values and biological reference points (such as F40).

Halliday and Pinhorn (2002) reviewed the scientific and technical basis for policies on the capture of small fish in North Atlantic groundfish fisheries. They note that these regulations are usually justified as a way to increase yields or to improve recruitment. An objective of increasing recruitment requires an assumption that there is a direct relationship between SSB and recruitment. This report is ambivalent about the utility of such regulations, noting that many of the presumed benefits may not be realized. This report, however, does not explicitly address the changes in yield per recruit realized with NE groundfish over time.

The impacts of removing minimum size regulations are difficult to predict because of the interactions with minimum mesh regulations and other factors that affect selectivity (time and area fished, targeting behavior, etc.). Mesh characteristics are only one factor that determines the selectivity of the fishery but are believed to be important for trawls and gillnets. While it is sometimes argued that requiring full retention will merely convert discards to landings and not affect the catch at age, this assumption may not prove valid if profits can be increased by targeting smaller fish. This is explored further in a following section. If removing minimum fish sizes leads to a change in fishing behavior such that smaller fish are increasingly selected by the fishery, then there will be changes in the yield per recruit (YPR) and biological reference points (including Fmsy and SSB_{MSY} or their proxies). These changes were explored by the PDT to determine the likely magnitude of the changes and their impacts on potential yields.

Table 1 summarizes the changes in YPR for four stocks that are used as examples: witch flounder, GB haddock, CC/GOM yellowtail flounder, and GOM cod. Using the selectivity as determined by the 2012 groundfish updates or SARC 53 as a starting point,

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[1] Ocean pout, windowpane flounder, Atlantic wolffish, and SNE/MA winter flounder are not allocated and retention is prohibited.

changes at age were examined in quarter-year increments for their impact on YPR. As can be seen from the tables, a shift in selectivity of one year reduces the YPR for these stocks between 9.4 pct (GOM cod) to 4.6 pct (GB haddock). The value of F40 for these stocks declines from 18.5 pct (GOM cod) to 30 pct (GB haddock, witch flounder). Over the long term, these changes would lead to reduced catches at a given stock size and a reduced value for MSY.

While this analysis focuses on changes in YPR, it does not address possible changes in recruitment. For some groundfish stocks there is evidence that older, larger fish have higher fecundity. Older, larger fish tend to produce more eggs, and more of the eggs survive to the larval stage. In some cases the differences are dramatic. For example, the number of yellowtail flounder eggs that are produced increases rapidly as size increases. YPR analyses do not address the changes in recruitment that may occur from reducing the number of older fish in the population.

Whether requiring full retention of allocated stocks would result in a shift in selectivity to younger ages will not be known until a few years after the regulatory change when an assessment is conducted. In the interim, ABCs/ACLs would normally be set based on the observed selectivity. Another consideration is the effect that a change in selectivity would have if catch quotas are based on a different selectivity pattern. The impacts are not necessarily easy to predict and are not obvious, because the selectivity pattern interacts with the age structure of the population, rebuilding requirements, and the changes in the fishing mortality reference point. As an example, the implications are explored for two representative stocks: GOM cod and CC/GOM yellowtail flounder. Note that these examples assume that there is no change in recruitment as a result of fishing on younger fish.

GOM Cod

For this analysis, a stock projection based on the SARC 53 assessment was performed. An estimated catch for 2011 and 2012 was used as an input, and then the catch at 75 pct of F_{MSY} is used for years 2014 through 2030. The catches, realized fishing mortality (F/F_{MSY}), SSB/SSB_{MSY} ratio, probability of overfishing, and probability of rebuilding are shown in the Table 2. This is considered the baseline projection.

A comparison to the baseline projection used a selectivity pattern shifted one year to younger ages. No adjustment was made to the selectivity at ages beyond the age of full recruitment. The same data elements are reported in Table 3. For the comparison to be valid, a new SSB_{MSY} was calculated using the F40 proxy that applies to the revised selectivity pattern. This projection used the same catches as were used in the baseline projection.

Comparing the two projections reveals that if the same catches are used in both projections (as would be the case if the ABCs were set for the entire time period based on the SARC 53 selectivity) and selectivity shifts to younger fish, the ratio of F/FMSY under the new selectivity is higher than in the baseline projection. Rebuilding would be slower (delayed about two years beyond the baseline projection) and the probability of overfishing is higher. The baseline and revised selectivity ratios of SSB/SSBMSY are plotted in Figure 2.

A more realistic scenario is shown in Table 4. This example assumes that the new selectivity is detected and ABCs for 2015 and beyond are set using this new pattern while fishing at 75 pct of FMSY. Catches would be lower and rebuilding occurs about one year later than the baseline projection.

CC/GOM yellowtail flounder

For this analysis, a stock projection based on the SARC 53 assessment was performed. An estimated catch for 2011 and 2012 was used as an input, and then the catch at 75 pct of F_{MSY} is used for years 2014 through 2023. The catches, realized fishing mortality (F/F_{MSY}), SSB/SSB_{MSY} ratio, probability of overfishing, and probability of rebuilding are shown in the Table 5. This is considered the baseline projection.

A comparison to the baseline projection used a selectivity pattern shifted one year to younger ages. No adjustment was made to the selectivity at ages beyond the age of full recruitment. The same data elements are reported in Table 6. For the comparison to be valid, a new SSB_{MSY} was calculated using the F40 proxy that applies to the revised selectivity pattern. This projection used the same catches as were used in the baseline projection.

Comparing the two projections reveals that if the same catches are used in both projections (as would be the case if the ABCs were set for the entire time period based on the SARC 53 selectivity) and selectivity shifts to younger fish, the ratio of F/FMSY under the new selectivity is higher than in the baseline projection. Rebuilding time would be almost the same and the probability of overfishing is higher.

A more realistic scenario is shown in Table 7. This example assumes that the new selectivity is detected and ABCs for 2015 and beyond are set using this new pattern while fishing at 75 pct of FMSY. Catches would be about ten percent lower in each year of the rebuilding period.

Conclusions

For the two examples shown, a change in selectivity to younger ages would result in a reduction in yields over the long term. It does not appear that there would be an increase in fishing mortality in the short term that would be caused by fishing on a quota that was set with a different selectivity.

Evaluating the Likelihood of a Selectivity Change

While it is sometimes argued that removing minimum size regulations will just convert discards to landings, it is possible that the selectivity pattern may change for some or all species. This would depend, in part, on whether fishermen can increase profits by targeting smaller fish. Whether this will occur depends on several factors, including whether there is a price differential for a species that is based on size, whether it is easy to target smaller fish, and the relative abundance of different size fish. If fishermen can catch smaller fish more quickly and thus reduce operating costs then a change in selectivity is more likely.

The potential for changes in selectivity can be inferred from the fact that for some stocks, fishermen targeted smaller fish in the recent past. For example, the minimum sizes in the late 1980's were smaller than they are now for most groundfish stocks. This is not conclusive, however, since the regulatory system was very different. The fishery was open access and there no limits on effort or landings.

Price differential: If the price difference between large and small fish is large, then targeting small fish will only be profitable if the increased catch rates reduce operating costs sufficiently to outweigh the premium for larger fish. If the difference is small or non-existent it is more likely that small fish will be targeted since generally they are more abundant. 2011 dealer prices were examined for seven groundfish species. Prices are only available for fish that presumably met minimum size requirements; it is unknown if these prices reflect the price that may be received for fish smaller than the current minimum sizes.

Each documented sale to a dealer was treated as a price observation, and box plots were created for each species by reported market category (Figure 2). Cod, haddock, plaice, witch flounder, white hake, and redfish generally show increasing price per pound as size increases. There are some exceptions, however – for example, market and scrod haddock had similar prices in 2011, whale cod prices were generally lower than large cod, and redfish prices were similar for all market sizes except large. Yellowtail flounder prices were generally similar for all market categories. Winter flounder prices were similar at all categories with the exception of lemon sole. Halibut prices were similar for all market categories.

Ease of targeting: The ability to target smaller fish depends on a number of factors – relative abundance, spatial and temporal distribution of different sizes, and whether fishing practices need to be revised. Otter trawls can potentially change the number of small fish they catch simply by changing from diamond to square mesh. While there are numerous factors that affect selectivity, including time and area fished; this is one that is easily observed. Observed trawl trips (NEGEAR =050) for 2010 and 2011 (NEFOP) were queried to determine the length-frequency of species catch with diamond and square mesh codend (mesh size 5.5 inches or greater). As can be seen in the accompanying plots (Figure 3), changing the type of mesh towed can change the size of fish caught for cod, pollock, yellowtail flounder, and winter flounder. It appears to do little to affect the size of haddock, witch flounder and plaice that are caught.

Based on these analyses, it would appear more probable that eliminating the minimum size could lead to a change in selectivity for yellowtail flounder and winter flounder than for other stocks. There is little price differential between the current sizes landed and simply changing the type of cod-end used can modify the size of fish caught. A change may be less likely to occur for cod because of the price differential between large and small fish.

Gear In Use

The previous paragraph summarized differences in selectivity between diamond and square mesh, and showed that for some species diamond mesh selects for smaller fish. Whether a change in mesh would lead to a shift in fishery selectivity depends what mesh is currently used. As shown in Figure 4, observed trawl tows (NEGEAR=050) retaining groundfish use diamond mesh more often than square mesh. In the GOM and GB there appears to have been a shift to more frequent use of diamond mesh on observed tows since 2006. Assuming that the mesh used on observed tows reflects that used on unobserved tows, roughly 30 percent of tows could be shifted to diamond mesh.

Conclusion

There is a potential that removing minimum size limits will result in increased targeting of smaller fish for some groundfish species. Relatively minor changes in behavior – such as using a particular mesh configuration – can lead to this result.

Discussion

While there does appear to be the potential that requiring full retention by removing minimum size and possession limits may result in a change of fishery selectivity, as long as catches are adequately monitored and the change can be detected in reasonable amount of time it should not lead to biological concerns for most groundfish stocks. If there is a shift, the long term impacts are that fishery yields will decline, F_{MSY} or its proxy will likely decline, and SSB_{MSY} or its proxy will probably increase. Rebuilding periods may be extended if adjustments are not made to projected catches to account for the change in selectivity. These changes should be anticipated and planned for.

Table 1 – Impact of changes in selectivity on YPR for four groundfish stocks

GB haddock

age	status quo	"1/4	"1/2	"3/4	"1 age
1	0.018048	0.03	0.04	0.045	0.059397
2	0.059397	0.09	0.13	0.18	0.222259
3	0.222259	0.25	0.29	0.33	0.384552
4	0.384552	0.44	0.53	0.61	0.707236
5	0.707236	0.84	0.93	0.99	1
6	1	1	1	1	1
7	1	1	1	1	1
8	1	1	1	1	1
9	1	1	1	1	1
F40	0.3872	0.3492	0.3153	0.2903	0.2692
ypr	0.49168	0.486	0.48	0.47483	0.46917
ratio	1	0.988448	0.976245	0.96573	0.954218

witch fld

age	status quo	"1/4	"1/2	"3/4	"1 age
3	0.011	0.02	0.022	0.03	0.039
4	0.039	0.05	0.055	0.069	0.091
5	0.091	0.15	0.22	0.31	0.42
6	0.427	0.59	0.78	0.93	1
7	1	1	1	1	1
8	1	1	1	1	1
9	1	1	1	1	1
10	1	1	1	1	1
11	1	1	1	1	1
F40	0.2718	0.2287	0.213	0.1995	0.1896
ypr	0.20682	0.20118	0.19795	0.19471	0.19194
ratio	1	0.97273	0.957112	0.941447	0.928053

CC gom YT

age	status quo	"1/4	"1/2	"3/4	"1 age
1	0.001	0.015	0.03	0.062	0.064
2	0.064	0.14	0.26	0.39	0.486
3	0.486	0.64	0.79	0.92	1
4	1	1	1	1	1
5	1	1	1	1	1
6	1	1	1	1	1
F40	0.2594	0.2382	0.2178	0.2007	0.1917
ypr	0.21265	0.20811	0.20342	0.19883	0.19674
ratio to sq	1	0.97865	0.956595	0.935011	0.925182

GOM cod

age	status quo	"1/4	"1/2	"3/4	"1 age
1	0.02	0.036	0.05	0.072	0.109
2	0.109	0.17	0.22	0.31	0.395
3	0.395	0.5	0.63	0.75	0.844
4	0.844	0.92	0.95	0.98	1
5	1	1	1	1	1
6	1	1	1	1	1
7	0.896	0.896	0.896	0.896	0.896
8	0.88	0.88	0.88	0.88	0.88
9	0.673	0.673	0.673	0.673	0.673
F40	0.1962	0.1852	0.1765	0.1674	0.1599
ypr	1.20128	1.17111	1.14553	1.11565	1.0884
ratio sq	1	0.974885	0.953591	0.928718	0.906034

Table 2 – GOM cod projection using SARC 53 inputs

		FMSY:	0.2	SSBMSY:	61218		
Year	Catch	F	F/FMSY	SSB	SSB/SSBMSY	Prob Over	Prob.Rebuilt
2011	7750	0.92	4.60	9478	0.15	1.000	0.000
2012	6700	0.879	4.40	8168	0.13	0.995	0.000
2013	1961	0.2	1.00	10235	0.17	0.500	0.000
2014	2463	0.15	0.75	16376	0.27	0.220	0.000
2015	3525	0.1496	0.75	23379	0.38	0.220	0.000
2016	4484	0.1495	0.75	30195	0.49	0.232	0.010
2017	5387	0.1491	0.75	36947	0.60	0.224	0.046
2018	6298	0.1499	0.75	43815	0.72	0.220	0.128
2019	7061	0.1499	0.75	50941	0.83	0.220	0.279
2020	7683	0.1502	0.75	57045	0.93	0.220	0.414
2021	8128	0.1496	0.75	61641	1.01	0.223	***0.508***
2022	8499	0.15	0.75	65248	1.07	0.219	0.567
2023	8762	0.1493	0.75	68080	1.11	0.217	0.616
2024	8938	0.1491	0.75	70324	1.15	0.214	0.651
2025	9105	0.1496	0.75	71952	1.18	0.215	0.674
2026	9193	0.1496	0.75	72896	1.19	0.213	0.686
2027	9281	0.15	0.75	73558	1.20	0.215	0.697
2028	9338	0.1492	0.75	74564	1.22	0.212	0.707
2029	9395	0.1489	0.74	74960	1.22	0.213	0.715
2030	9455	0.1498	0.75	75507	1.23	0.211	0.719
Total	143406						

Table 3 - GOM cod projection using SARC 53 inputs but revised selectivity in 2013 and beyond

		FMSY:	0.1599	SSBMSY:	62900		
Year	Catch	F	F/FMSY	SSB	SSB/SSBMSY	Prob Over	Prob.Rebuilt
2011	7750	0.92	*4.60*	*9478*	*0.15*	1.00	0.00
2012	6700	0.8787	*4.40*	*8168*	*0.13*	0.99	0.00
2013	1961	0.1293	0.81	10281	0.16	0.27	0.00
2014	2463	0.1082	0.68	16445	0.26	0.14	0.00
2015	3525	0.1175	0.73	23388	0.37	0.20	0.00
2016	4484	0.1236	0.77	30117	0.48	0.24	0.01
2017	5387	0.1266	0.79	36932	0.59	0.26	0.04
2018	6298	0.1309	0.82	43633	0.69	0.28	0.11
2019	7061	0.1342	0.84	50510	0.80	0.30	0.23
2020	7683	0.1369	0.86	55892	0.89	0.32	0.36
2021	8128	0.1385	0.87	59777	0.95	0.34	0.44
2022	8499	0.1408	0.88	62552	0.99	0.35	0.49
2023	8762	0.1425	0.89	64613	1.03	0.37	***0.53***
2024	8938	0.1441	0.90	65906	1.05	0.38	0.55
2025	9105	0.1459	0.91	66657	1.06	0.39	0.56
2026	9193	0.1474	0.92	66906	1.06	0.40	0.57
2027	9281	0.1485	0.93	67073	1.07	0.42	0.57
2028	9338	0.1499	0.94	66753	1.06	0.42	0.57
2029	9395	0.1509	0.94	66657	1.06	0.44	0.56
2030	9455	0.1526	0.95	66589	1.06	0.45	0.56

Figure 1 – GOM cod SSB/SSBMSY under two selectivity scenarios

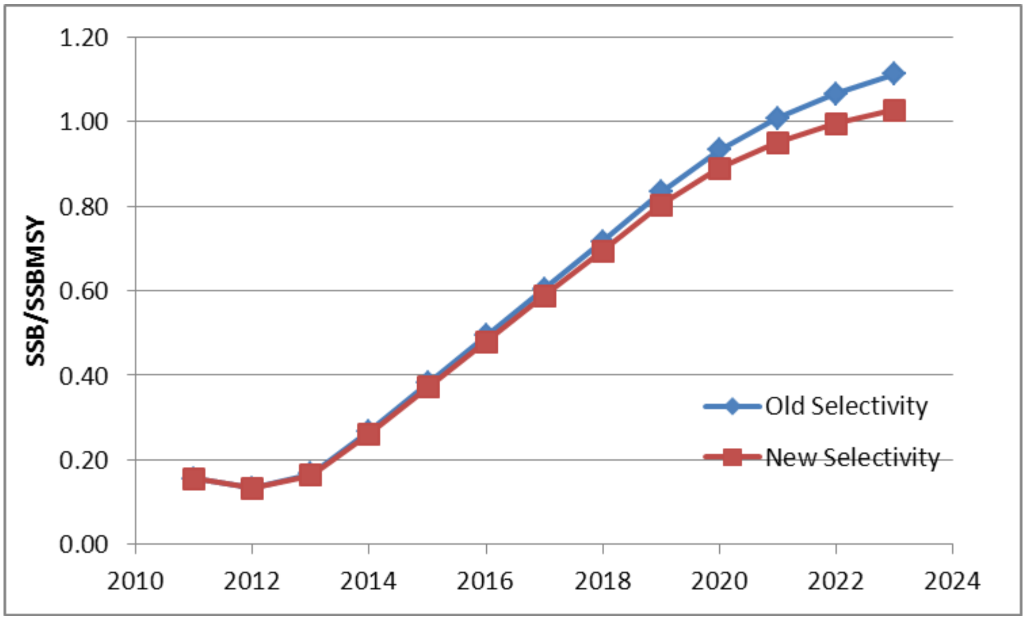


Table 4 – GOM cod projection with revised selectivity and new catches based on 75 pct of FMSY beginning in 2015

75% FMSY after 2015		FMSY:	0.1599	SSBMSY:	62900		
Year	Catch	F	F/FMSY	SSB	SSB/SSBMSY	Prob Over	Prob.Rebuilt
2011	7750	0.92	*4.60*	*9478*	*0.15*	1.00	0.00
2012	6700	0.8787	*4.40*	*8168*	*0.13*	0.99	0.00
2013	1961	0.1293	0.81	10281	0.16	0.27	0.00
2014	2463	0.1082	0.68	16445	0.26	0.14	0.00
2015	3594	0.1199	0.75	23375	0.37	0.21	0.00
2016	4349	0.1199	0.75	30080	0.48	0.22	0.01
2017	5117	0.1198	0.75	37034	0.59	0.22	0.04
2018	5820	0.1196	0.75	44062	0.70	0.21	0.11
2019	6438	0.1198	0.75	51484	0.82	0.21	0.25
2020	6928	0.1196	0.75	57585	0.92	0.21	0.39
2021	7322	0.1197	0.75	62356	0.99	0.21	0.49
2022	7610	0.1195	0.75	66086	1.05	0.20	***0.56***
2023	7839	0.1196	0.75	69120	1.10	0.20	0.61
2024	8011	0.1198	0.75	71412	1.14	0.20	0.64
2025	8144	0.12	0.75	73113	1.16	0.19	0.66
2026	8220	0.1199	0.75	74154	1.18	0.19	0.68
2027	8297	0.1199	0.75	75135	1.19	0.19	0.70
2028	8355	0.12	0.75	75672	1.20	0.19	0.71
2029	8390	0.1197	0.75	76154	1.21	0.19	0.71
2030	8443	0.1199	0.75	76664	1.22	0.19	0.72

Table 5 – CC/GOM yellowtail flounder projection using SARC 53 inputs

		FMSY:	0.26	SSBMSY:	7.080		
Year	Catch	F	F/FMSY	SSB	SSB/SSBMSY	Prob Over	Prob.Rebuilt
2011	747	0.3353	1.29	2.8442	0.402	0.95	0
2012	950	0.3718	1.43	2.9221	0.413	0.974	0
2013	549	0.1952	0.75	3.4581	0.488	0.0733	0
2014	719	0.1947	0.75	4.528	0.640	0.0592	0.0244
2015	888	0.1943	0.75	5.4332	0.767	0.0788	0.1134
2016	1048	0.1945	0.75	6.2754	0.886	0.0921	0.2881
2017	1177	0.1944	0.75	6.9591	0.983	0.1103	0.4704
2018	1267	0.1943	0.75	7.4591	1.054	0.1207	0.5901
2019	1331	0.1933	0.74	7.8211	1.105	0.1276	0.6612
2020	1370	0.1925	0.74	8.0686	1.140	0.1264	0.7
2021	1399	0.1924	0.74	8.2303	1.162	0.1322	0.7253
2022	1416	0.1918	0.74	8.3539	1.180	0.1339	0.7422
2023	1430	0.1913	0.74	8.4361	1.192	0.1355	0.7453

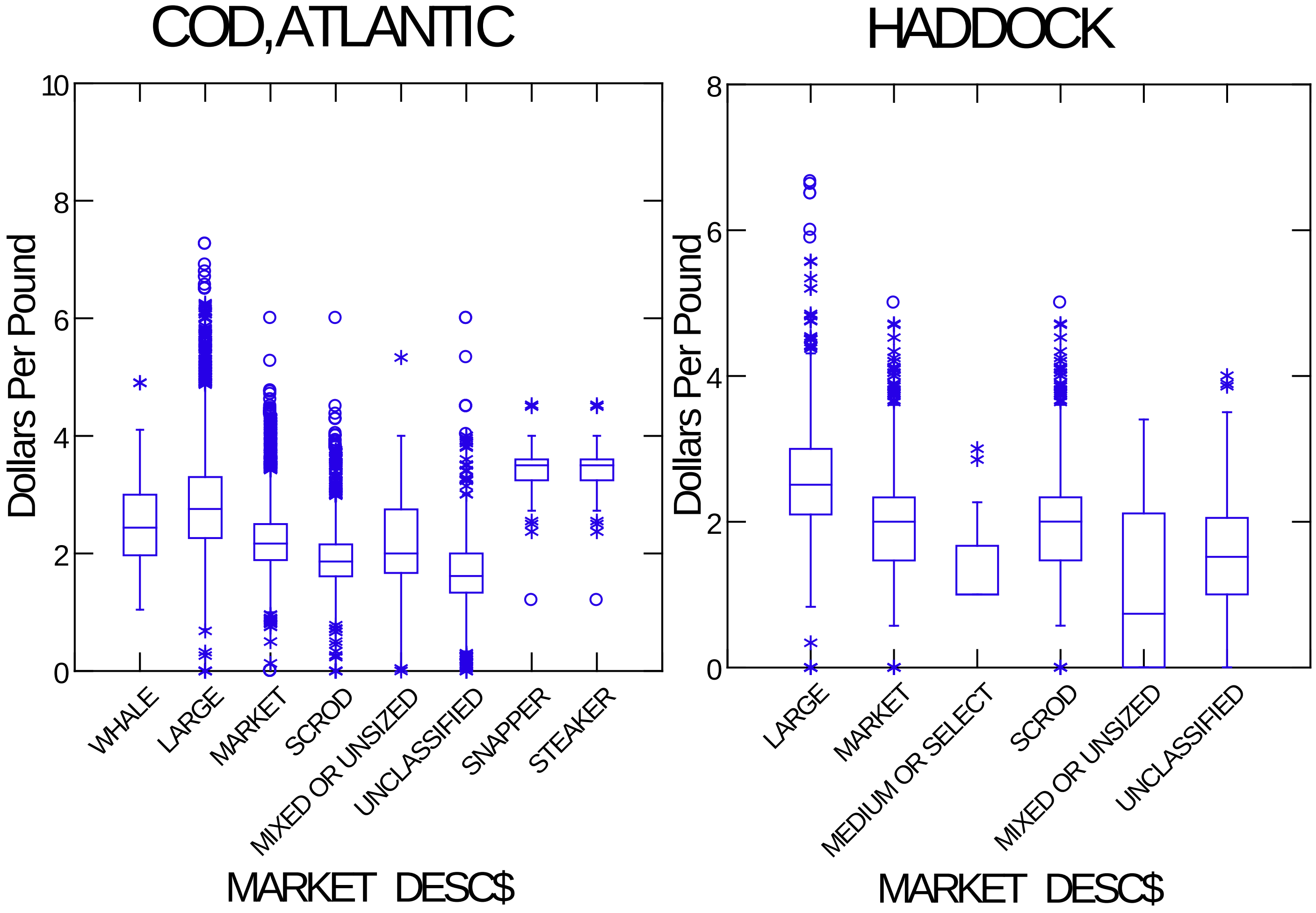
Table 6 – CC/GOM yellowtail flounder projection using SARC 53 inputs but revised selectivity in 2013 and beyond

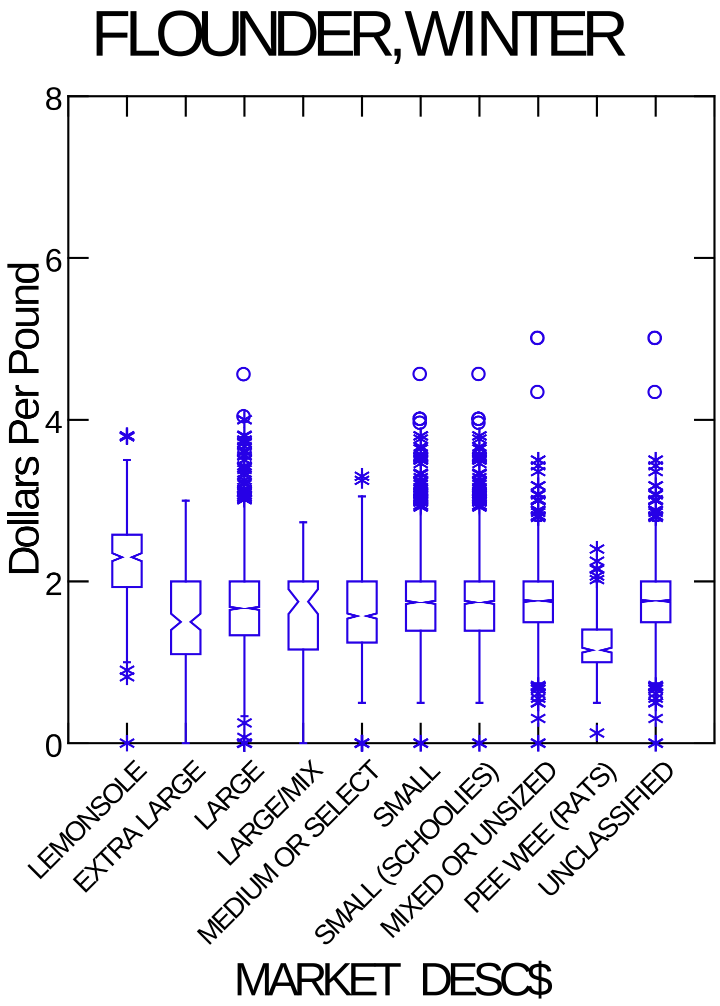
		FMSY:	0.1917	SSBMSY:	7.120		
Year	Catch	F	F/FMSY	SSB	SSB/SSBMSY	Prob Over	Prob.Rebuilt
2011	747	0.3353	1.29	2.8442	0.402	0.95	0
2012	950	0.3718	1.43	2.9221	0.413	0.974	0
2013	549	0.1321	0.69	3.4914	0.490	0.0087	0
2014	719	0.1361	0.71	4.5615	0.641	0.0265	0.0235
2015	888	0.145	0.76	5.416	0.761	0.0674	0.1071
2016	1048	0.1518	0.79	6.1989	0.871	0.1212	0.2574
2017	1177	0.1567	0.82	6.8155	0.957	0.1788	0.4245
2018	1267	0.1604	0.84	7.2275	1.015	0.2177	0.5249
2019	1331	0.1645	0.86	7.4763	1.050	0.2462	0.5784
2020	1370	0.1649	0.86	7.6459	1.074	0.2669	0.6057
2021	1399	0.1669	0.87	7.7218	1.085	0.2859	0.6206
2022	1416	0.168	0.88	7.7745	1.092	0.2982	0.6297
2023	1430	0.1685	0.88	7.8132	1.097	0.3126	0.6349

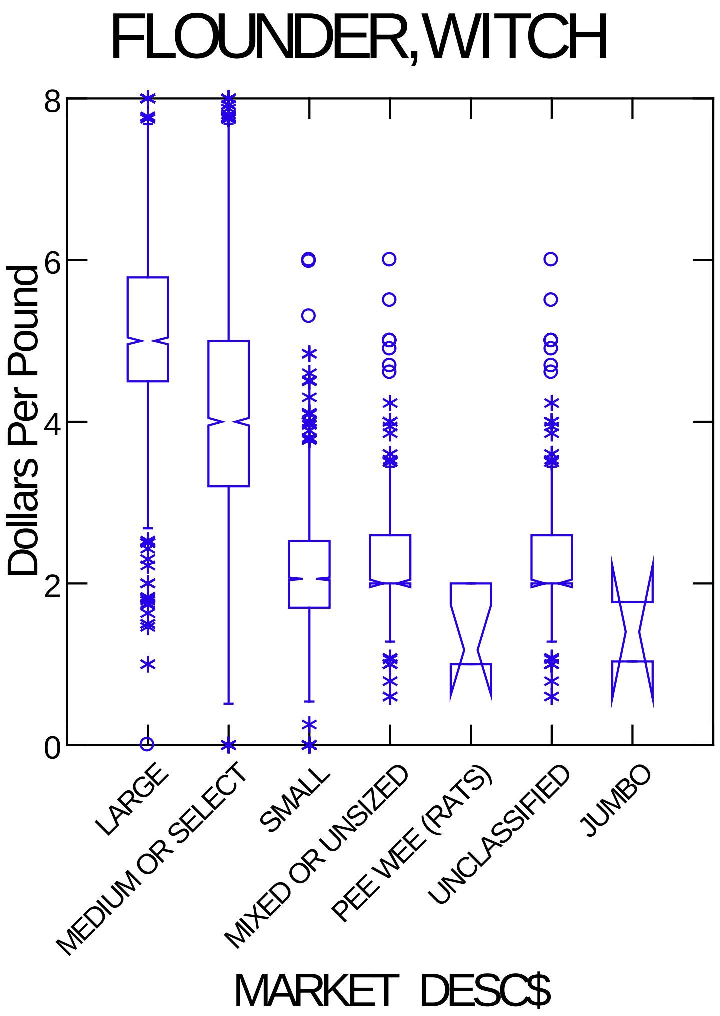
Table 7 – CC/GOM yellowtail flounder projection with revised selectivity and new catches based on 75 pct of FMSY beginning in 2015

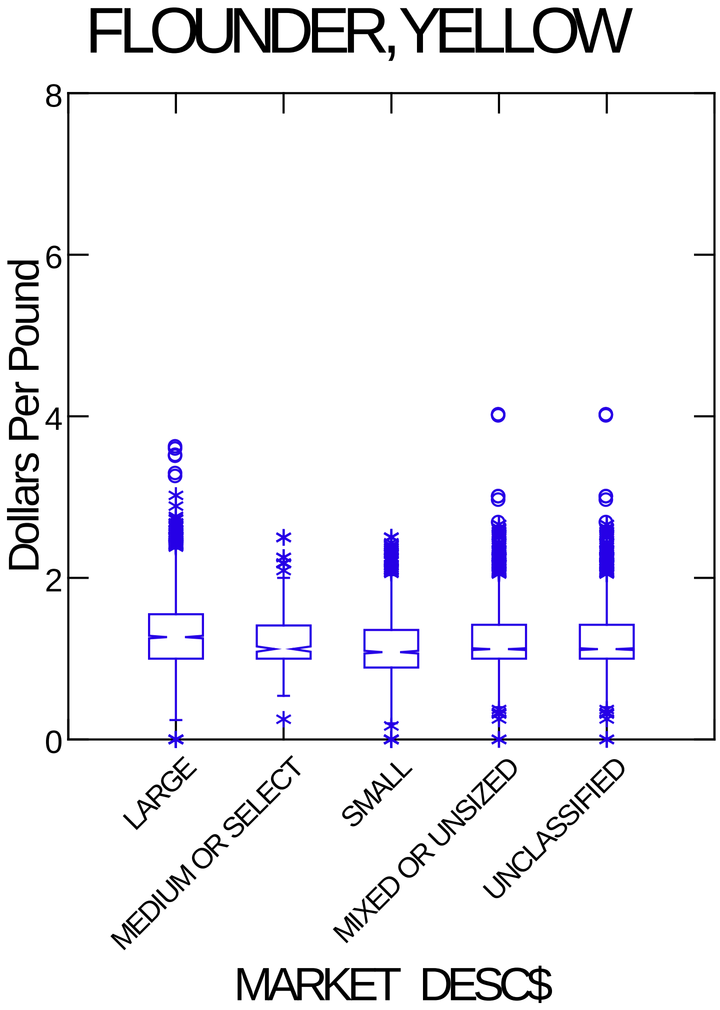
75% FMSY after 2015		FMSY:	0.1917	SSBMSY:	7.120		
Year	Catch	F	F/FMSY	SSB	SSB/SSBMSY	Prob Over	Prob.Rebuilt
2011	747	0.3353	1.29	2.8442	0.402	0.95	0
2012	950	0.3718	1.43	2.9221	0.413	0.974	0
2013	549	0.1321	0.69	3.4914	0.490	0.0087	0
2014	719	0.1361	0.71	4.5615	0.641	0.0265	0.0235
2015	850	0.1384	0.72	5.4306	0.763	0.0395	0.1084
2016	964	0.1381	0.72	6.2687	0.880	0.0474	0.2718
2017	1063	0.1383	0.72	6.9812	0.981	0.0595	0.4645
2018	1138	0.139	0.73	7.504	1.054	0.069	0.5909
2019	1190	0.1392	0.73	7.8687	1.105	0.0782	0.6671
2020	1225	0.1388	0.72	8.1544	1.145	0.0807	0.7139
2021	1251	0.1389	0.72	8.332	1.170	0.084	0.7454
2022	1270	0.139	0.73	8.4706	1.190	0.0871	0.7636
2023	1284	0.1386	0.72	8.5896	1.206	0.087	0.7793

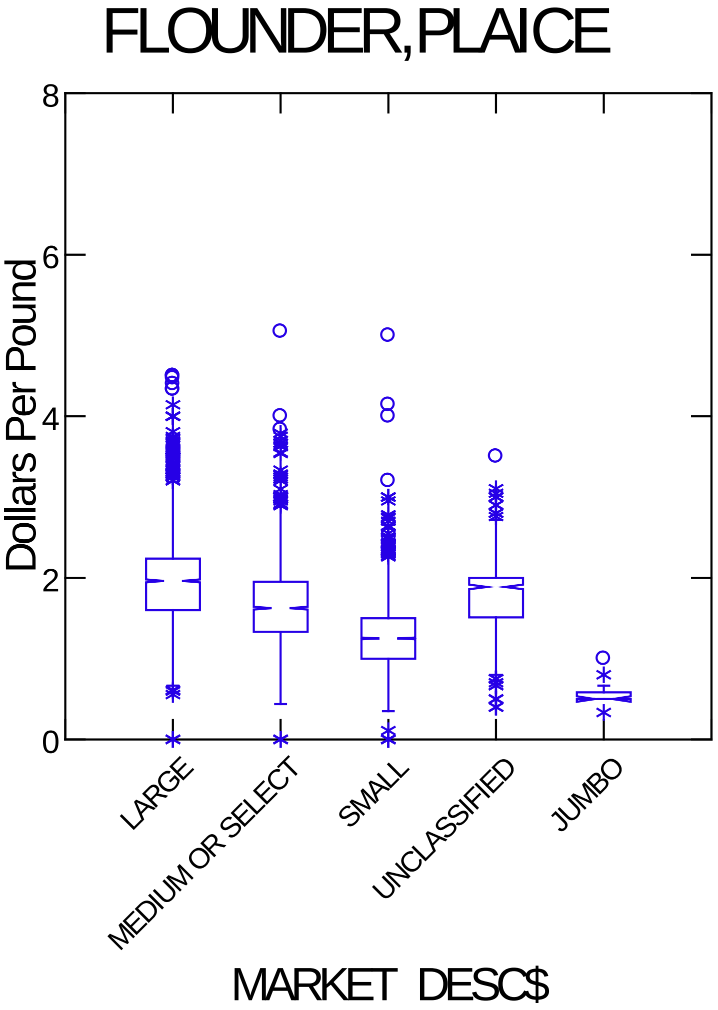
Figure 2 – Average price by market category for key groundfish stocks (Source: NMFS dealer data, 2011)

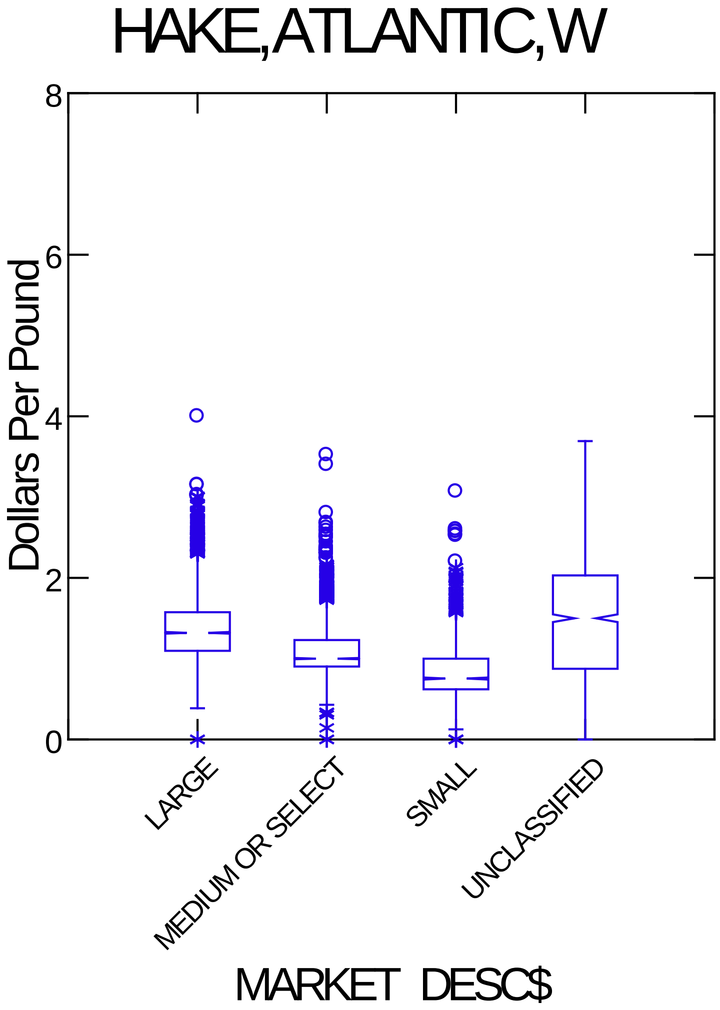


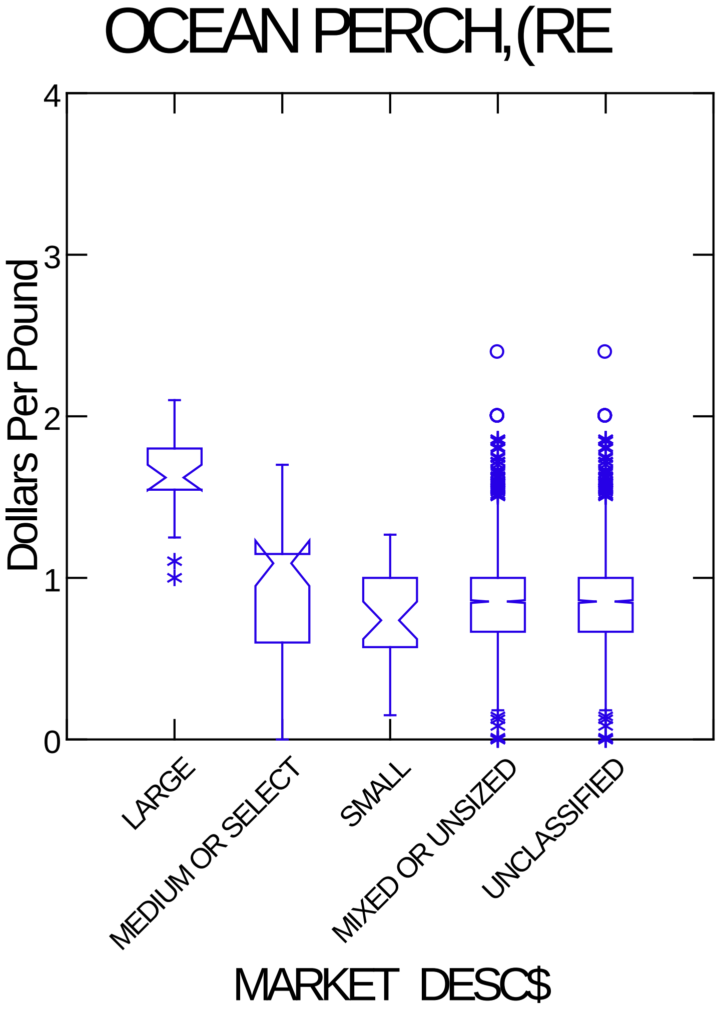

FLOUNDER,WINTER
Dollars Per Pound
0
2
4
6
8
LEMONSOLE
EXTRA LARGE
LARGE
LARGE/MIX
MEDIUM OR SELECT
SMALL
SMALL (SCHOOLIES)
MIXED OR UNSIZED
PEE WEE (RATS)
UNCLASSIFIED
MARKET DESC$


FLOUNDER,WITCH
Dollars Per Pound
0
2
4
6
8
LARGE
MEDIUM OR SELECT
SMALL
MIXED OR UNSIZED
PEE WEE (RATS)
UNCLASSIFIED
JUMBO
MARKET DESC$


FLOUNDER,YELLOW
Dollars Per Pound
0
2
4
6
8
LARGE
MEDIUM OR SELECT
SMALL
MIXED OR UNSIZED
UNCLASSIFIED
MARKET DESC$


FLOUNDER,PLAICE
Dollars Per Pound
0
2
4
6
8
LARGE
MEDIUM OR SELECT
SMALL
UNCLASSIFIED
JUMBO
MARKET DESC$


HAKE,ATLANTIC,W
Dollars Per Pound
0
2
4
6
8
LARGE
MEDIUM OR SELECT
SMALL
UNCLASSIFIED
MARKET DESC$


OCEAN PERCH,(RE
Dollars Per Pound
0
1
2
3
4
LARGE
MEDIUM OR SELECT
SMALL
MIXED OR UNSIZED
UNCLASSIFIED
MARKET DESC$

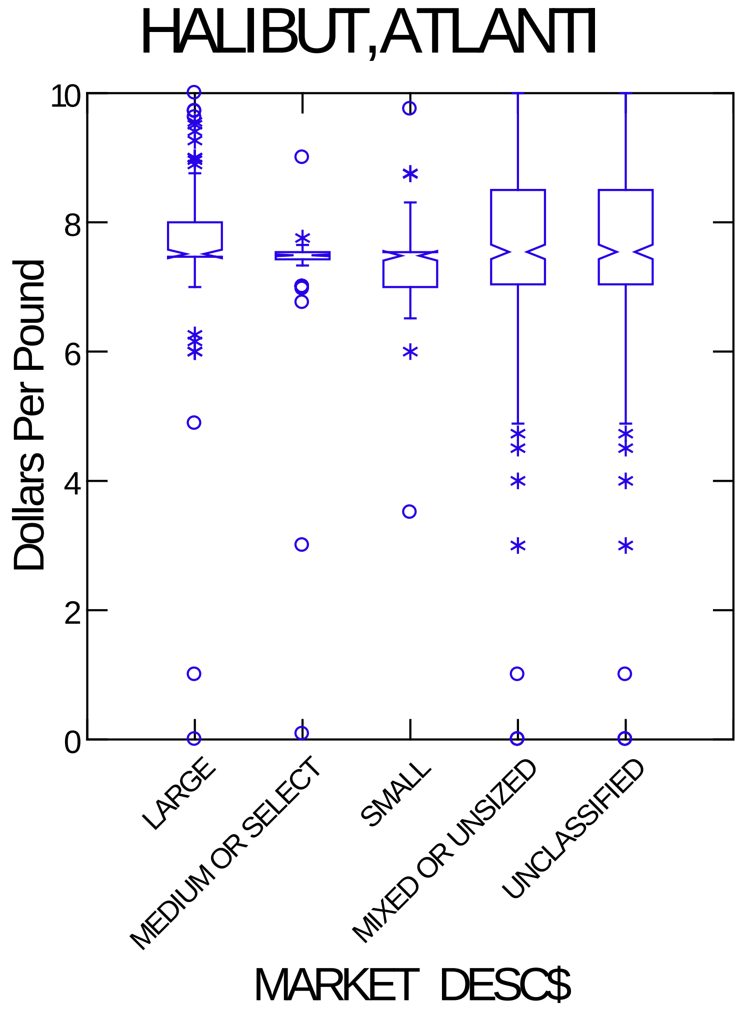
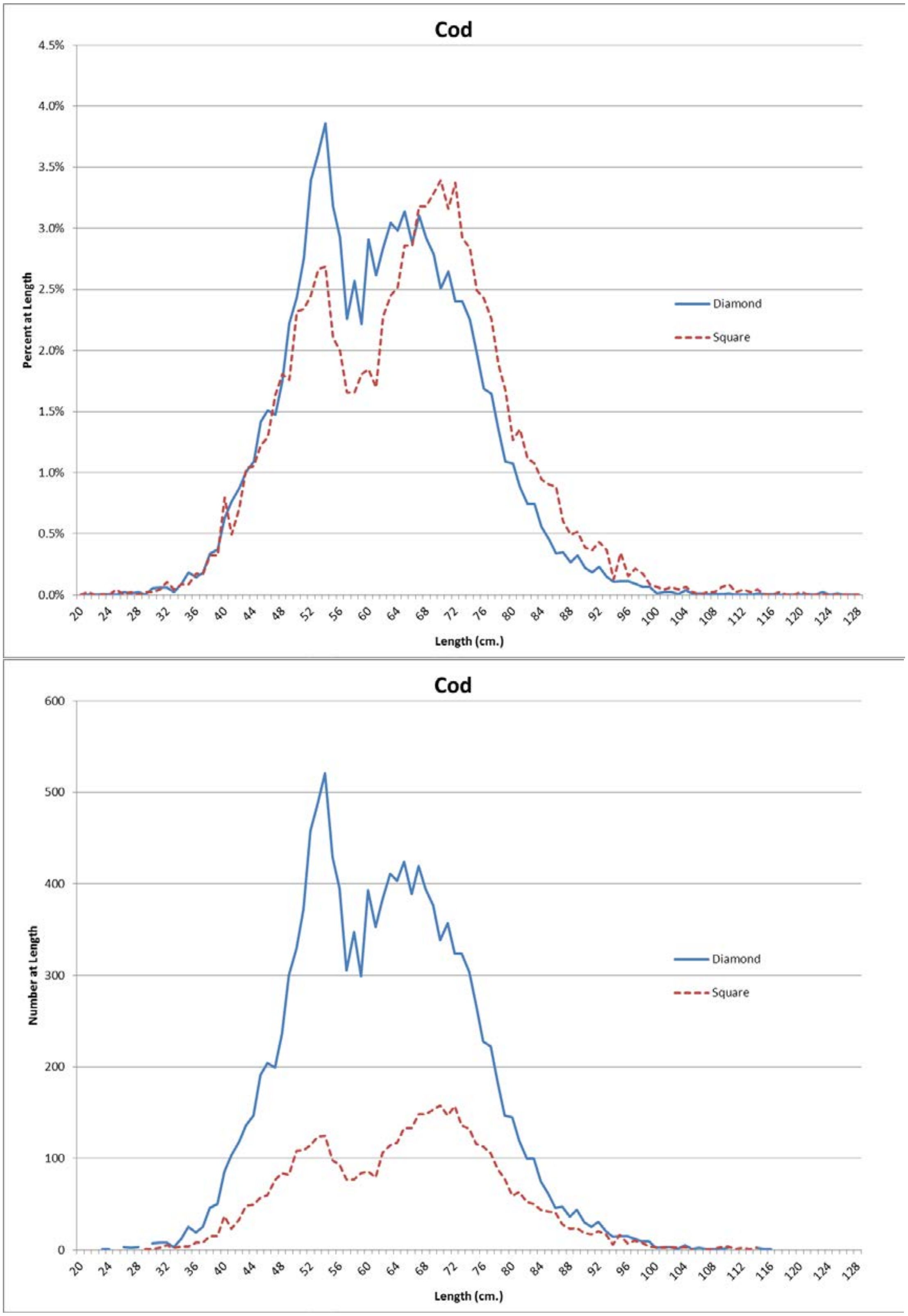
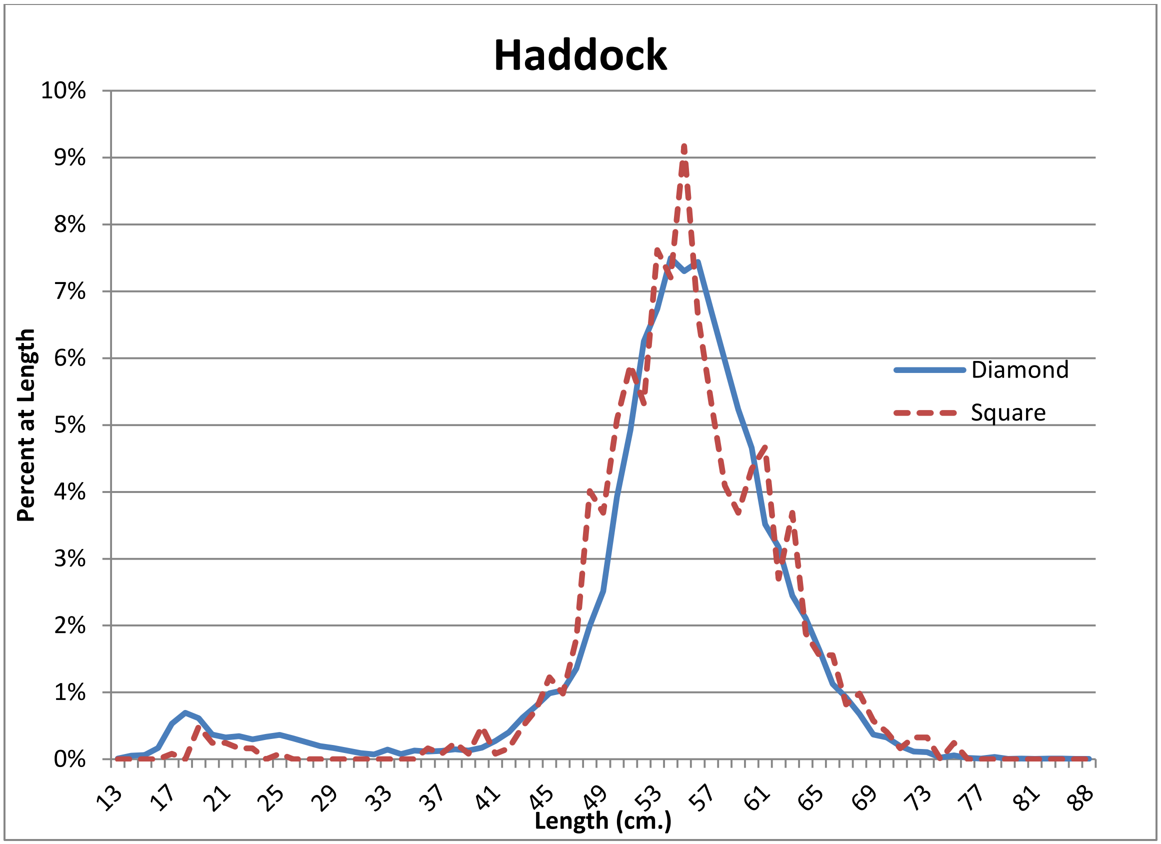
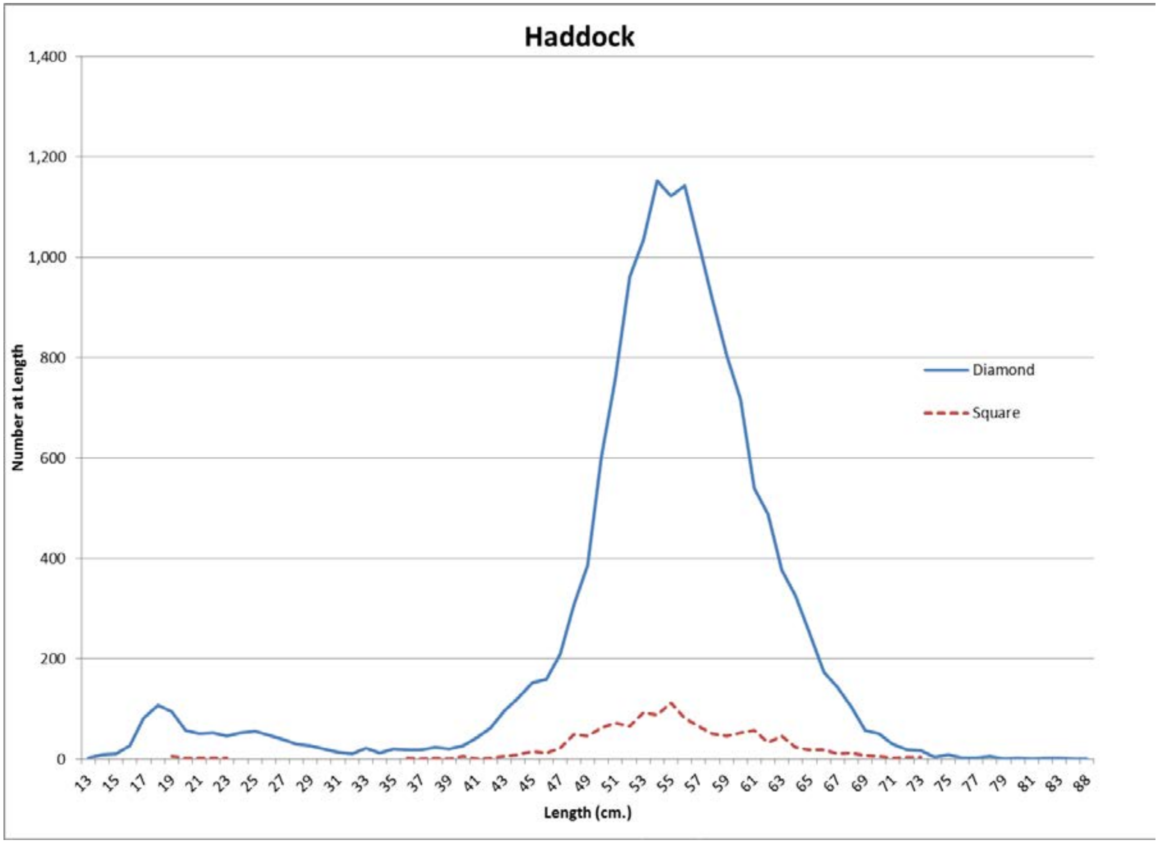
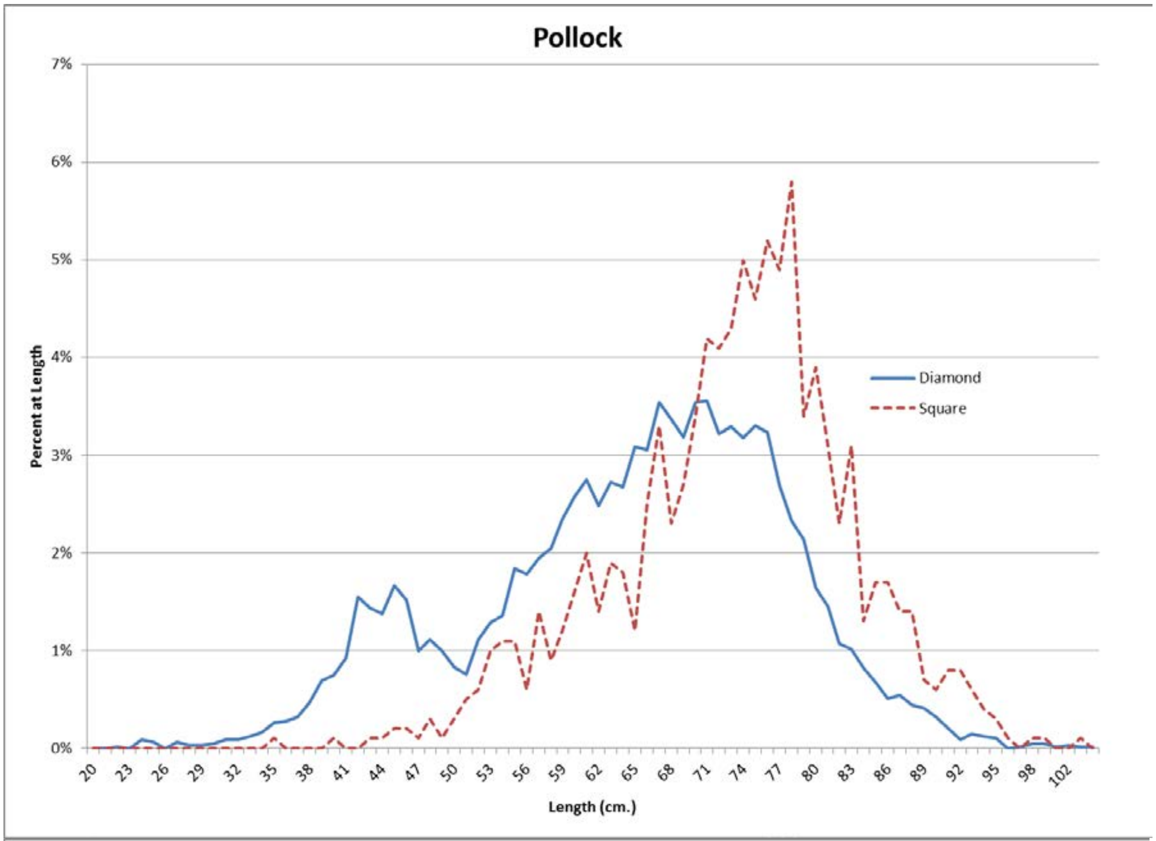

HALIBUT,ATLANTI
Dollars Per Pound
0
2
4
6
8
10
LARGE
MEDIUM OR SELECT
SMALL
MIXED OR UNSIZED
UNCLASSIFIED
MARKET DESC$

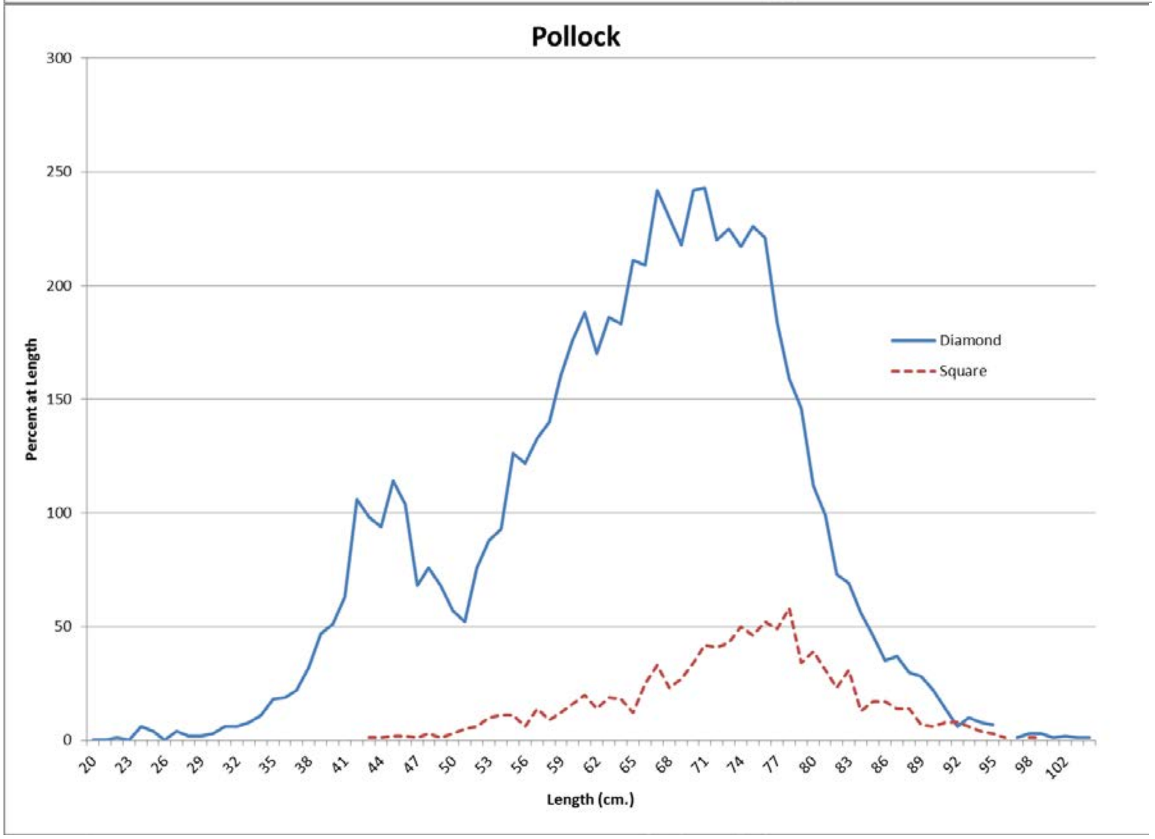
Figure 3 – Length-frequency of key groundfish species with different trawl mesh configurations

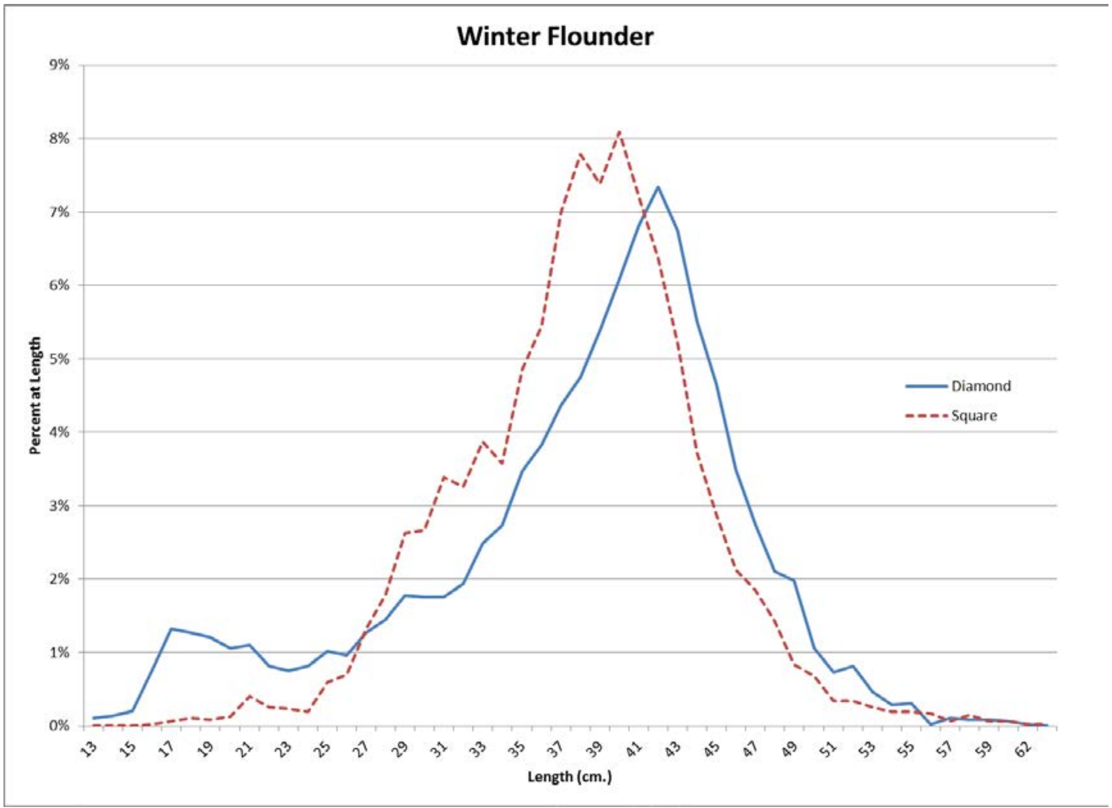


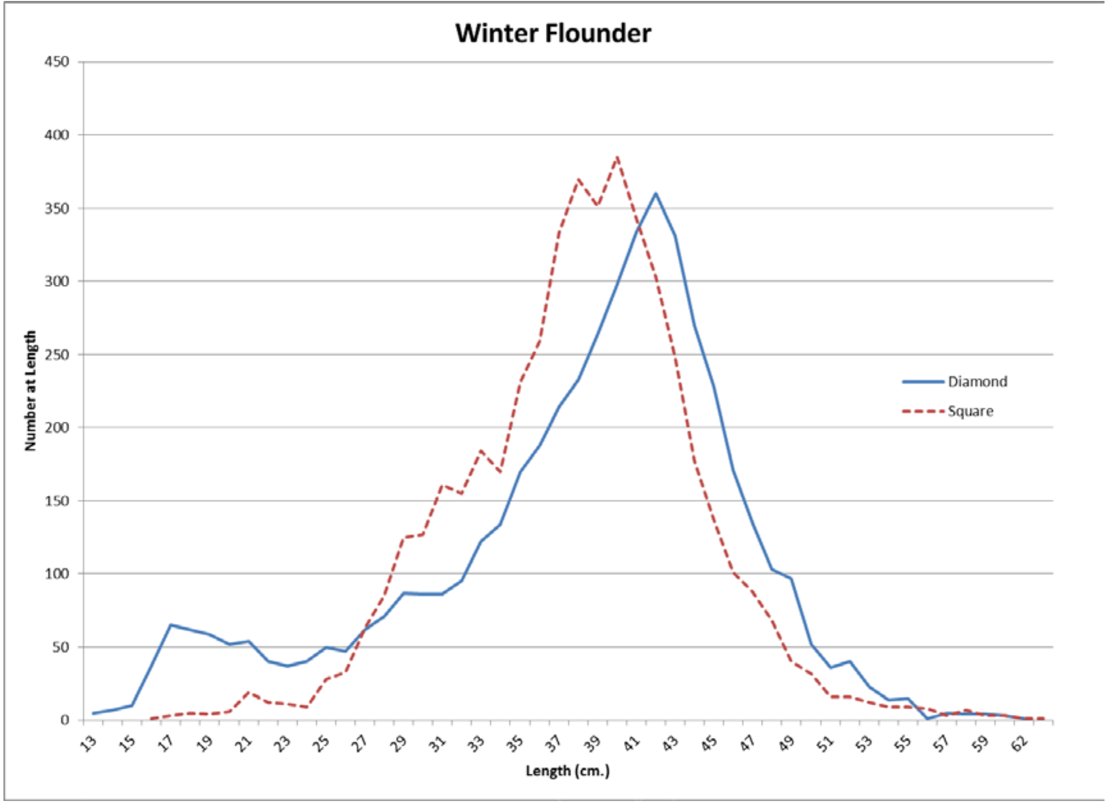

Haddock
Percent at Length
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
13
17
21
25
29
33
37
41
45
49
53
57
61
65
69
73
77
81
88
Length (cm.)
Diamond
Square

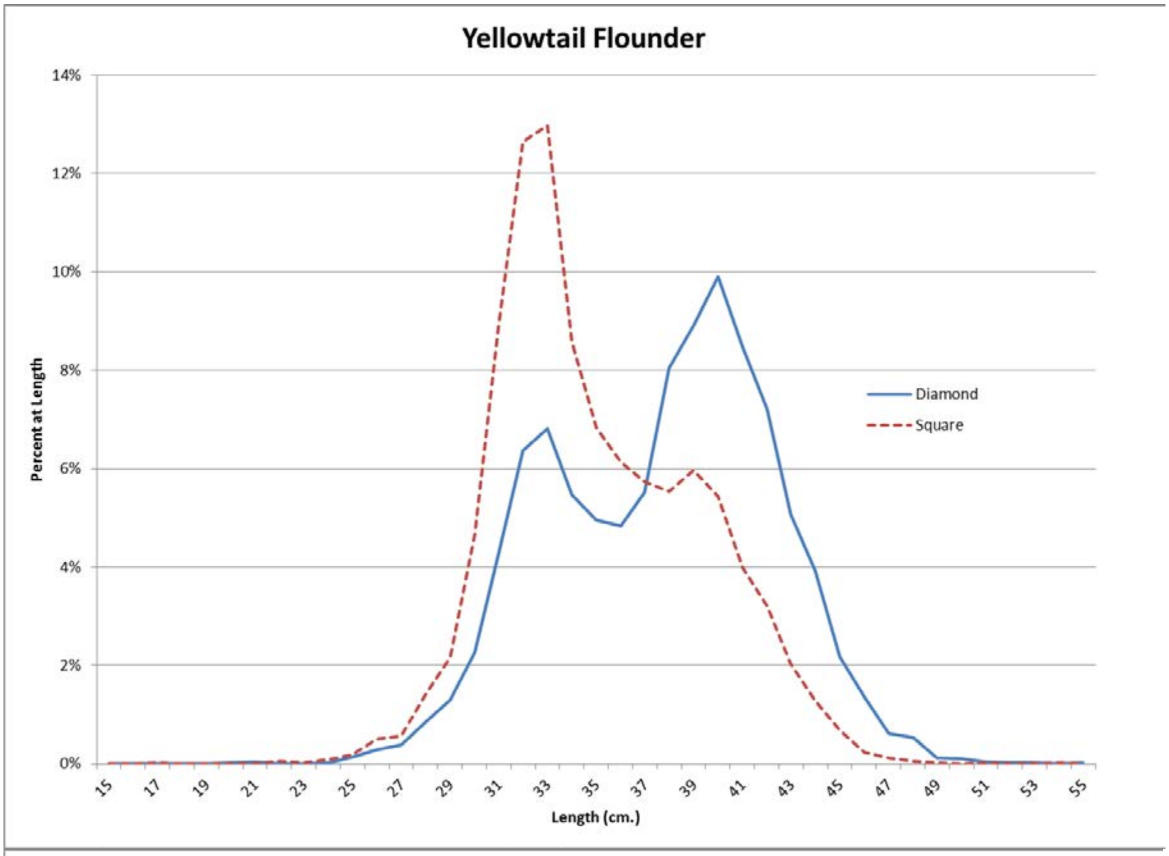

Haddock
Number at Length
1,400
1,200
1,000
800
600
400
200
0
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
88
Length (cm.)
Diamond
Square

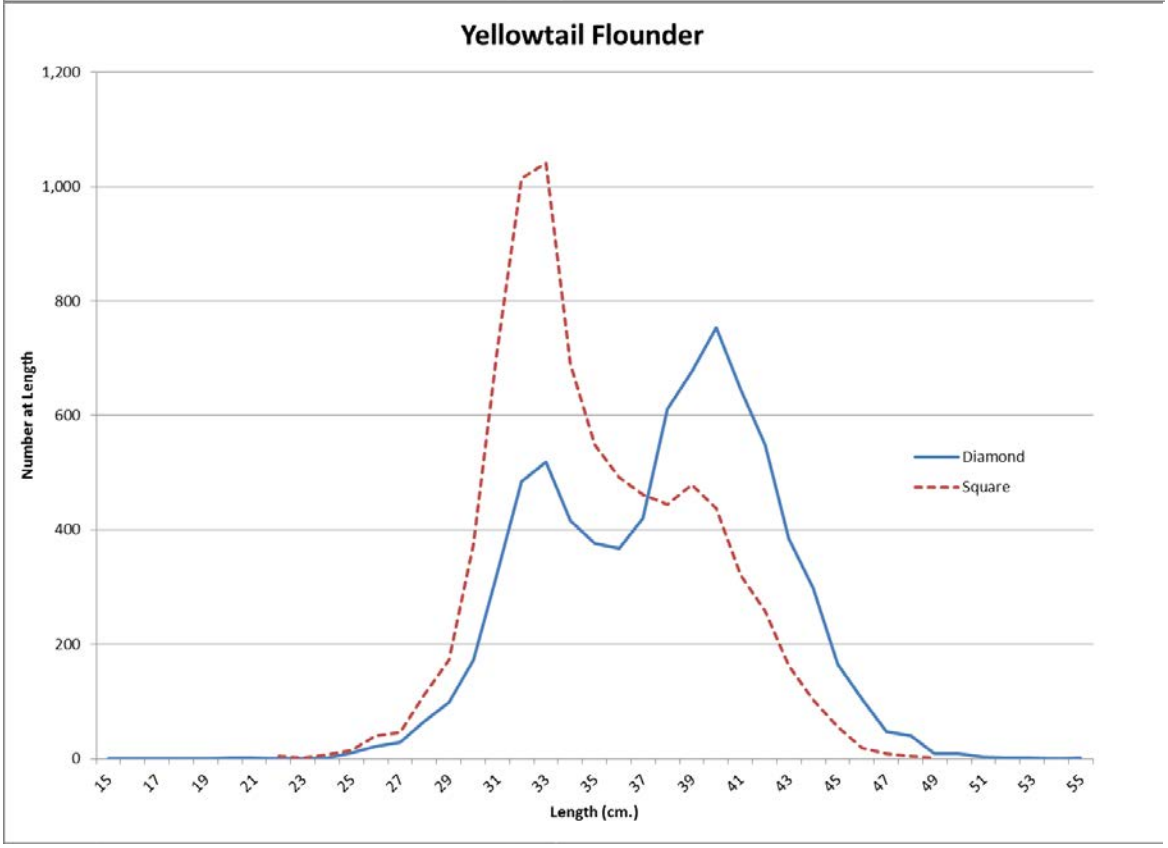

Pollock
7%
6%
5%
4%
3%
2%
1%
0%
Percent at Length
20
23
26
29
32
35
38
41
44
47
50
53
56
59
62
65
68
71
74
77
80
83
86
89
92
95
98
102
Length (cm.)
Diamond
Square

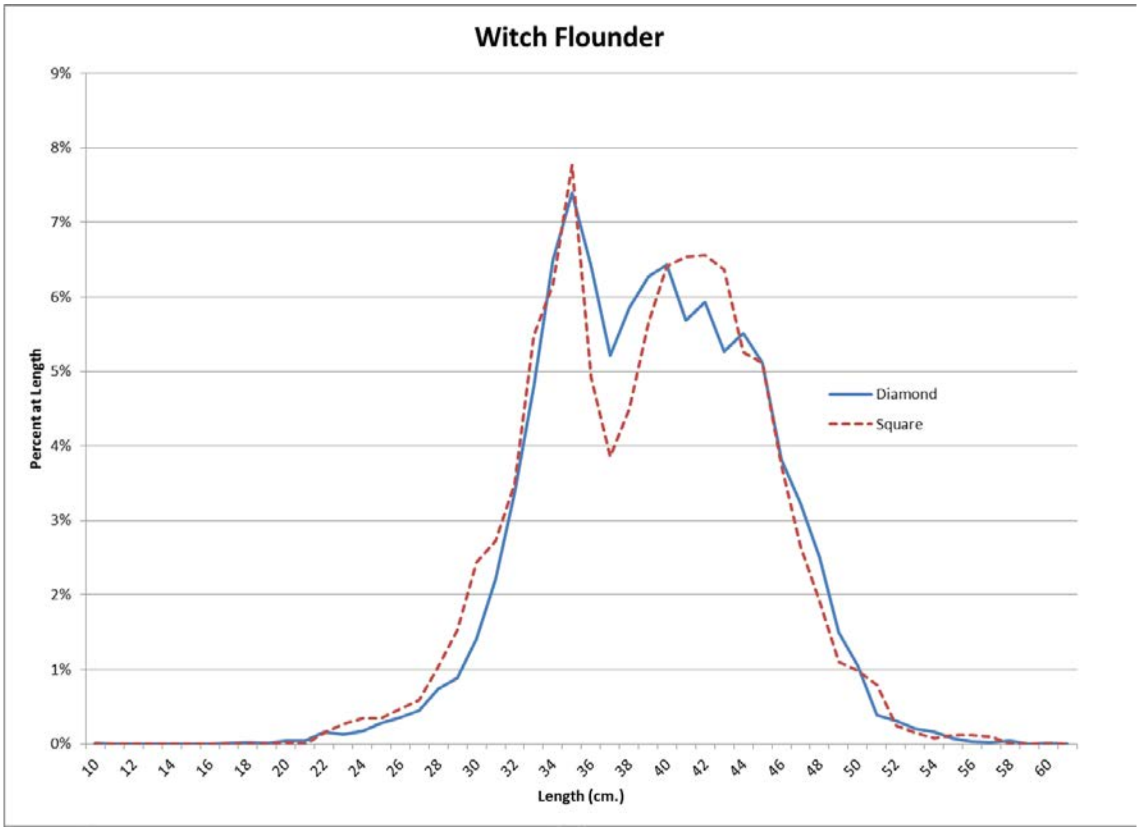

Pollock
300
250
200
150
100
50
0
Percent at Length
20
23
26
29
32
35
38
41
44
47
50
53
56
59
62
65
68
71
74
77
80
83
86
89
92
95
98
102
Length (cm.)
Diamond
Square

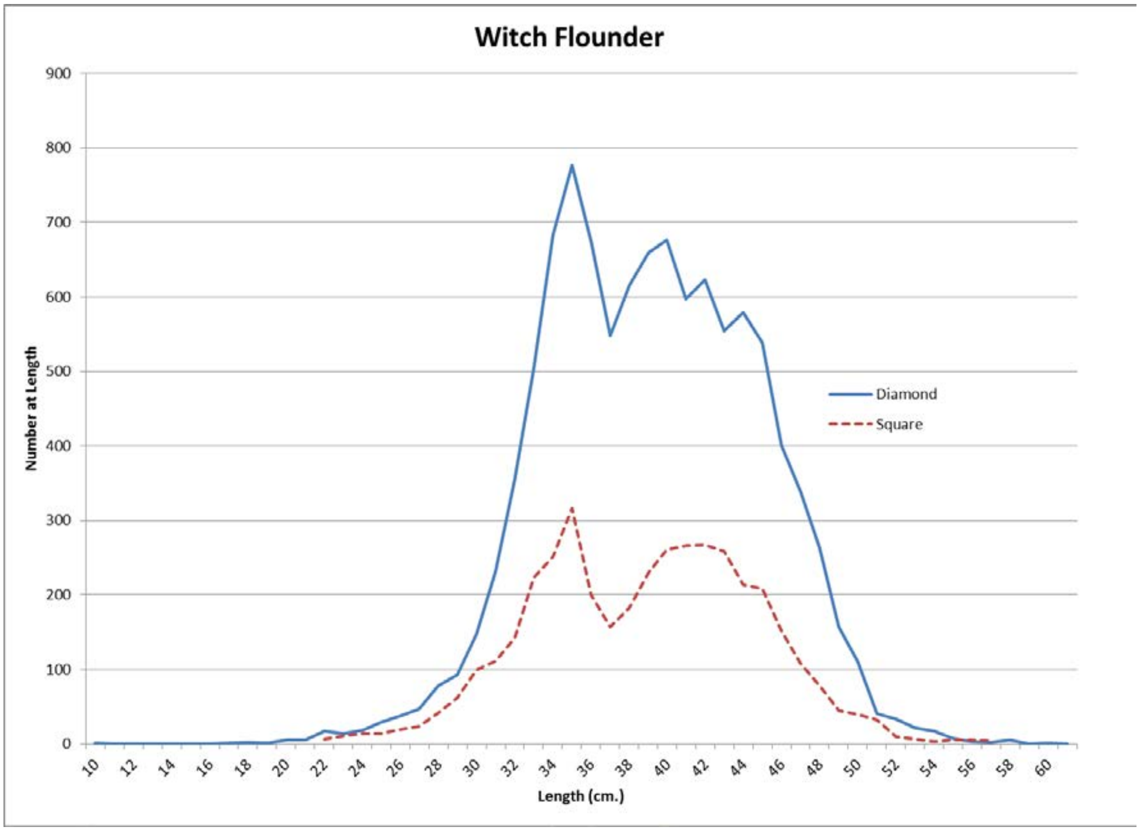

Winter Flounder
Percent at Length
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
51
53
55
57
59
62
Length (cm.)
Diamond
Square

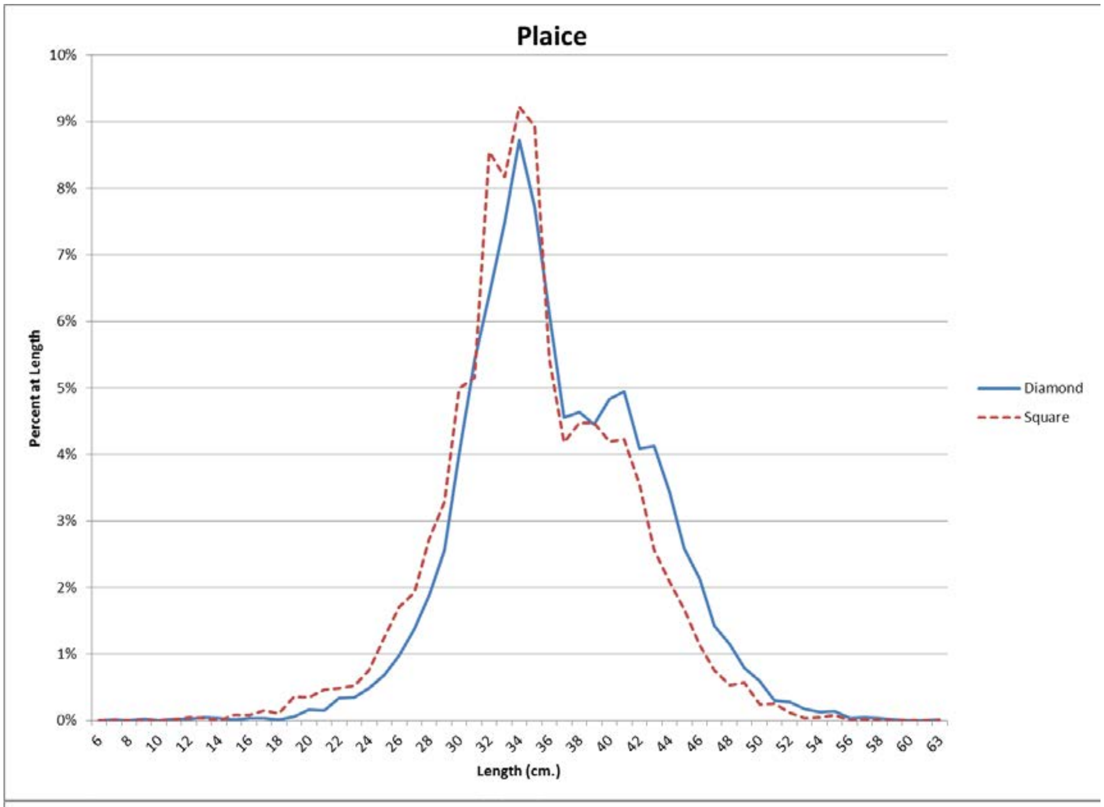

Winter Flounder
Number at Length
450
400
350
300
250
200
150
100
50
0
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
51
53
55
57
59
62
Length (cm.)
Diamond
Square


Yellowtail Flounder
Percent at Length
14%
12%
10%
8%
6%
4%
2%
0%
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
51
53
55
Length (cm.)
Diamond
Square


Yellowtail Flounder
Number at Length
1,200
1,000
800
600
400
200
0
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
51
53
55
Length (cm.)
Diamond
Square


Witch Flounder
Percent at Length
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
Length (cm.)
Diamond
Square


Witch Flounder
Number at Length
900
800
700
600
500
400
300
200
100
0
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
Length (cm.)
Diamond
Square


Plaice
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
Percent at Length
6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 63
Length (cm.)
Diamond
Square

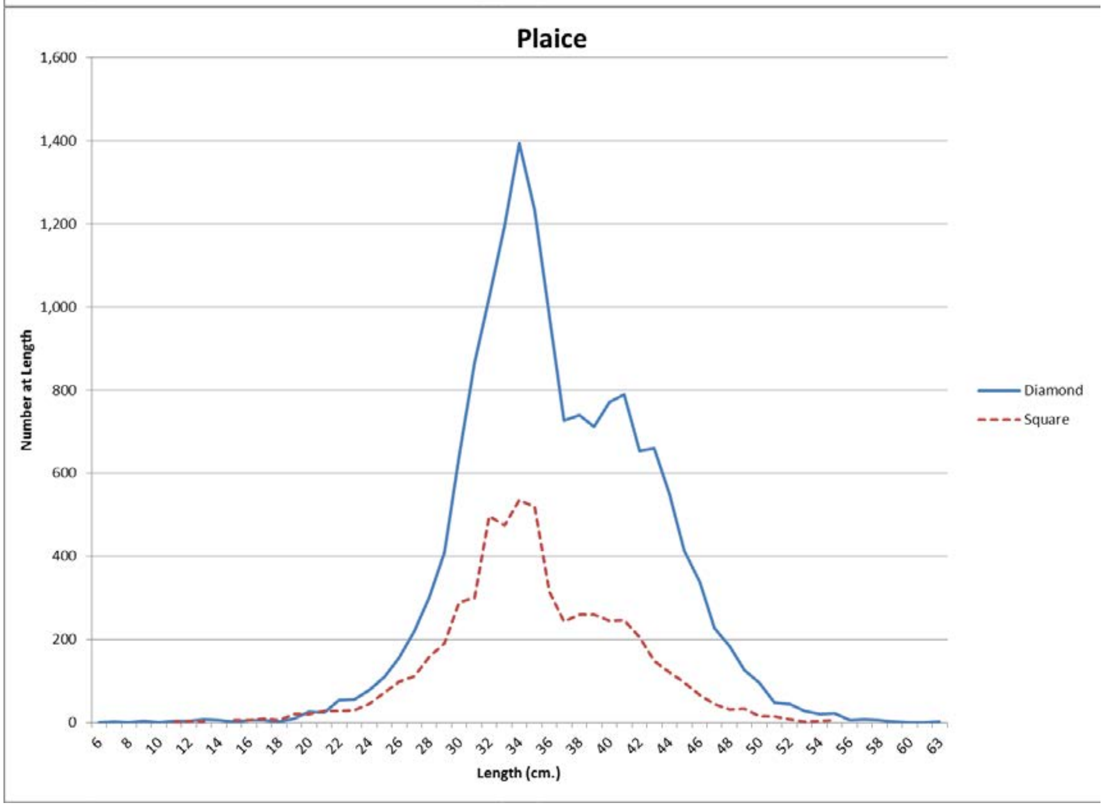

Plaice
1,600
1,400
1,200
1,000
800
600
400
200
0
Number at Length
6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 63
Length (cm.)
Diamond
Square

Figure 4 – Percent of observed large mesh otter trawl tows retaining groundfish that used one of four reported mesh configurations