Selective Targeting of Haddock Using Fabricated Bait: An industry motivated special access demonstration project

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ABSTRACT

Atlantic haddock stocks have recovered, particularly in groundfish closed areas on Georges Bank. The ability to selectively target haddock and avoid stocks of concern, such as cod, would be invaluable in implementing a haddock fishery without endangering the cod's tenuous recovery. Over 380,000 benthic longline hooks were baited with fabricated bait during 71 trips in Gulf of Maine and Georges Bank closures to test the bait's selectiveness in catching haddock and cod. The data support the hypothesis that fabricated bait catches haddock with a low incidence of cod. The overall catch per unit effort (CPUE) of haddock is 56 times greater than the CPUE of cod. The difference between haddock and cod mean CPUEs is significant ($P < 0.05$). Such a difference is likely to result from the effectiveness of fabricated baits in targeting haddock, but not from the absence of cod in the experimental areas. The verification of fabricated bait's capacity of selectively targeting haddock has a range of implications for fisheries management and fishing businesses, from facilitating rebuilding of species to creating new fishing opportunities.

INTRODUCTION

Georges Bank haddock is a primary New England groundfish stock. Georges Bank haddock spawning biomass was only 11 thousand mt in 1993 with landings of roughly 4 thousand mt. Historically, when haddock spawning biomass is above 75 thousand mt, the average year class size is over 5-fold larger and the odds of above average recruitment are 30-fold greater than when spawning biomass is below 75 thousand mt. Thus, spawning biomass is important for recruitment success of this stock. At present, Georges Bank haddock spawning biomass was projected to be about 120 thousand mt in 2003 (Brodziak et al, 2002). This is the highest abundance of adult spawners since 1967 and a 10-fold increase since 1993. The stock is about halfway to rebuilding to its target spawning biomass of 250 thousand mt (NEFSC, 2004).

Year round closures enacted under the Northeast Multispecies Fishery Management Plan (FMP) of the New England Fishery Management Council in 1995 aimed at rebuilding overfished stocks of yellowtail, haddock and cod (Federal Register, 1995). The haddock resource is rebuilding rapidly and is considered one of the most impressive success stories in New England fisheries management. On the other hand, cod rebuilding has been problematic and slow. A directed haddock fishery could be warranted if cod bycatch can be maintained at very low levels.

Bait preference among species lets fishermen direct on a desired species. For instance, cod prefer clams or squid while haddock will scavenge on practically anything (Bjordal, 1996). The selective nature of baited benthic longline fishing gear (Bjordal, 1996) provides a potential method for targeting haddock. Research by Norwegian scientists (Lokkeborg, 1992) has shown

three methods by which longliners can increase their haddock catches while greatly decreasing that of cod:

1. Replace squid with herring
2. Use smaller baits
3. Use a commercially available biodegradable fabricated bait

Previous research tested the first method, comparing the catch rates (lbs per hook) of cod and haddock when using both squid and herring as bait in Closed Area I on Georges Bank during October-December 2003. The cod catch rate using squid as bait was 0.13; using herring as bait reduced the catch rate by more than half to 0.06. The haddock catch rates were similar for the two bait types: 1.32 for herring and 1.66 for squid (Rudolph, 2004).

The fabricated bait suggested by the third method is manufactured by a process that restructures waste fish and fish offal from processing and mixes it with gelling agents, binders and other attractants. The formulaic mixture is subsequently extruded into a fiber mesh tube to form a continuous "sausage". The bait boasts a myriad of advantages for longline fishing vessels. Such advantages include no wastage, less preparation time, less bait, a higher baiting frequency, more bait delivered to the target, higher catches and less volume required for bait storage (Norbait, 2005).

OBJECTIVES

The objective of the experiment was to test the various fabricated baits' effectiveness at catching haddock and cod in fishing closures throughout New England, using benthic longline fishing gear. It was hypothesized that fabricated bait, when used in conjunction with benthic longline fishing gear, selectively targets haddock without catching cod. If the bait is actually selective, it should be effective regardless of spatial and temporal differences.

METHODS

The data presented here were collected through 324 benthic longline hauls exclusively using fabricated bait. A total of 380,720 hooks were set in areas of Closed Area I (CA1), Western Gulf of Maine Closure (WGOM), Rolling Closure III (Platts), Cashes Ledge Closure (Cashes), and Eastern U.S. Canada Resource Sharing Area (EUSCA). Figure 1 indicates general sampling areas; Table 1 indicates distribution of effort among the areas. The CA1 hauls were completed exclusively by small (36'-40') commercial hook and line dayboats during 49 trips. The EUSCA, Cashes and Inshore GOM hauls were completed by a diverse fleet of hook and line vessels, ranging from small dayboats to large (65') commercial auto-longliners.

All hauls were observed and processed by a trained, independent scientific data collector and met the guidelines set forth by the various Exempted Fishing Permits (EFP) necessary to perform the research. The actual round catch weights of each species (kept and discard) on a haul by haul basis were measured. When actual weight measurements of landed fish could not be obtained, estimated weights were determined by counting the number of individual fish and converting to dressed weight using the average landed weight per trip. Dressed weight was converted to round weight using the NMFS standard conversions for groundfish (1.17 cod, 1.14

haddock). Length measurements of all cod, all sublegal haddock, and 33% of legal haddock were also collected. On preliminary trips, a subset of adult haddock were weighed and measured to confirm that the length-weight relationships agreed with previous assessment data collected by NMFS (Brown & Hennemuth, 1971). Data were entered into the New England Fishery Science Center SeaSamp database, as well as CCCHFA's in-house database.

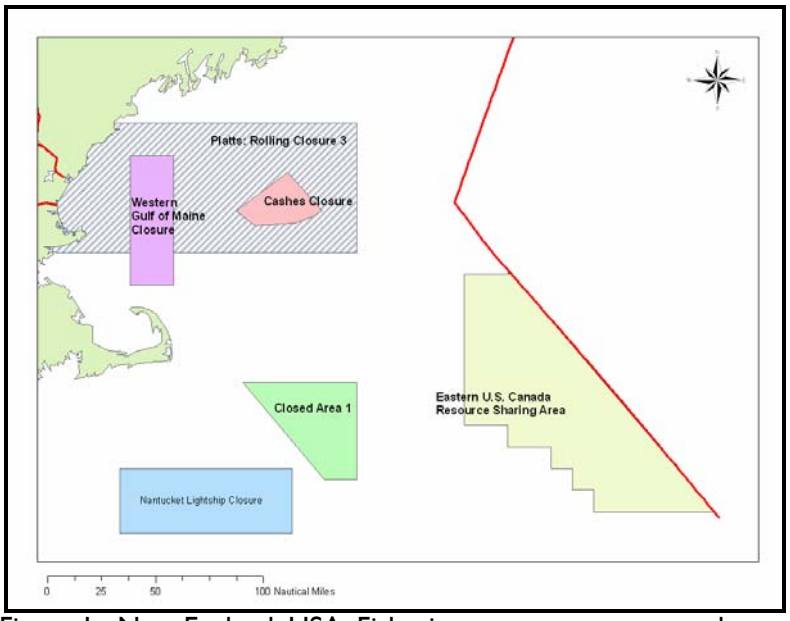


Figure 1: New England, USA: Fisheries management areas where research occurred are labeled in bold text.

Area	# Trips	# Hauls	# Hooks	Months Sampled
Georges Bank				
CA1	49	185	176,263	Feb, July-Dec
EUSCA	7	76	115,150	June, July
Gulf of Maine				
Cashes	2	10	16,700	Jan, May
WGOM	12	47	60,287	Jan, Feb, May
Platts	1	6	12,320	May
Grand Total	***71***	***324***	***380,720***	

Table 1: Effort Distribution

The data in this analysis were retrieved from the official SeaSamp database to ensure replicable analysis. The exception are the May, June and July data from EUSCA, WGOM, Platts, and Cashes which was drawn from our in-house database. The substantial amount of sampling has prohibited timely retrieval of the recent data from SeaSamp. Length frequency data were only available from SeaSamp; the data plotted does not include the recent May, June, and July data. Legal and sublegal individuals were divided based on legal size measured in total length. However, the available length frequency data were measured in fork length.

The fabricated bait used in the experiment was one of three types: Norbait, Trident, and homemade. The primary bait used was Norbait, a herring-based sausage form manufactured in Norway. Trident is similar to Norbait, but manufactured in Akutan, Alaska. The homemade

bait was fabricated by Dr. Susan Goldhor in Cornell University's sausage lab and based on a recipe similar to the commercial baits, but modified to fishermen's size specifications.

RESULTS

Overall

The fabricated baits caught a total of 301,044 pounds of haddock and 5,375 pounds of cod, including legal sized fish and discarded sublegal and drop-off fish. The catch per unit effort (CPUE, lbs per hook) is 0.7907 and 0.0141, respectively (Table 2). The haddock and cod CPUEs remain relatively stable at 0.7803 and 0.0119 (Table 2) when looking at total landings (legal fish kept). Within Georges Bank, the CPUE for landed cod is 0.005 and 0.015 in CA1 and EUSCA, respectively. The landed haddock CPUE is 1.191 and 0.511 in CA1 and EUSCA, respectively (Table 3). Within the Gulf of Maine, the CPUE for landed cod is 0.026, 0.003, and 0.017 in WGOM, Platts, and Cashes, respectively. The landed haddock CPUE is 0.409, 0.099, and 0.143 in WGOM, Platts, and Cashes, respectively (Table 3).

Length-frequency results illustrate 3.2% of the total number of haddock caught were sublegal haddock; this is a rate of 15.4 sublegal haddock per trip, compared to 469 adult haddock per trip (Figure 2). Length-frequency results for total cod caught indicate a high relative amount of sublegal cod (45%); however, the actual number of fish caught is negligible: 119 sublegal cod were caught and released during the 22 months of the experiment, a rate of 2 sublegal cod per trip (Figure 3). The figures also illustrate the differences in sublegals and overall abundance of fish among the management areas sampled. CA1 had haddock catch rates of 3.8 sublegals per trip and 418 adults per trip, with cod catch rates of 0.041 sublegals per trip and 0.49 adults per trip. WGOM had haddock catch rates of 62.7 sublegals per trip and 756 adults per trip, with cod catch rates of 10 sublegals per trip and 10.2 adults per trip. The Cashes length-frequency data only represent a single trip, with 154 sublegal and 367 adult haddock, with 27 sublegal and 31 adult cod.

	Landed, lbs	Landed CPUE	Discard, lbs	Discard CPUE	Total, lbs	Total CPUE
Haddock	297,081	0.7803	3,963	0.0104	301,044	0.7907
Cod	4,519	0.0119	856	0.0022	5,375	0.0141

Table 2: Haddock and Cod landings and discards, reported in pounds (round weight) and catch per unit effort (CPUE) measured in pounds per hook.

	Cod landed	Cod CPUE	Haddock landed	Haddock CPUE	Cod discards	Cod CPUE	Haddock discards	Haddock CPUE
CA1	908	0.005	209,935	1.191	17.1	0.0001	845	0.005
EUSCA	1,725	0.015	58,850	0.511	47	0.0004	1,353	0.012
WGOM	1,558	0.026	24,634	0.409	633	0.010	1,045	0.173
Platts	38	0.003	1,217	0.099	57	0.005	237	0.019
Cashes	290	0.017	2,395	0.143	102	0.006	533	0.032

Table 3: Total landings and discards of cod and haddock, separated by closure areas, reported in pounds (round weight) and catch per unit effort (CPUE) measured in pounds per hook.

Georges Bank vs. Gulf of Maine

On Georges Bank (CA1 and EUSCA) the fabricated baits caught a total of 90% of the total haddock and 50.2% of the total cod caught in the experiment with 76.5% of the total effort. The Gulf of Maine area (Cashes, Platts, and WGOM), 10% of the total haddock and 49.8% of the total cod with 23.5% of the effort. (Table 5). The catch per unit effort (pounds of fish per hook) in the two areas varies: cod CPUE is 0.0094 and 0.0300 for Georges Bank and the Gulf of Maine, respectively; haddock CPUE is 0.9405 and 0.3366 for Georges Bank and the Gulf of Maine, respectively.

While the amount of cod landed in the two areas is similar, the skewed effort (76.6% in Georges Bank) would imply that the CPUE is a better measure. CPUE in the two areas, for cod landed and discarded, have an order of magnitude difference (Table 6). The skewed effort is apparent in the haddock landings, with 90% of the haddock being landed from Georges Bank and a three-fold increase in CPUE. The haddock discards did have similar amounts between areas, but an order of magnitude difference in CPUE (Table 7).

	Cod Total, lbs	Haddock Total, lbs	Cod CPUE	Haddock CPUE
Georges Bank	2,697 (50.2%)	270,984 (90%)	0.0093	0.9299
Gulf of Maine	2,678 (49.8%)	30,060 (10%)	0.0300	0.3366

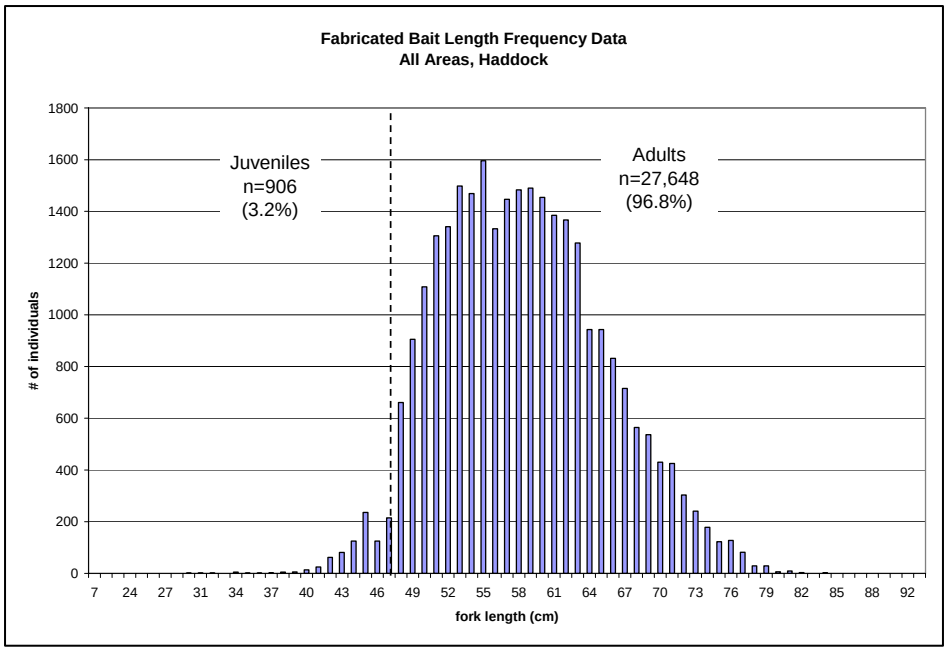
Table 5: Breakdown of cod and haddock totals by general area. Georges Bank includes Closed Area I and EUSCA data. Gulf of Maine includes Cashes Ledge, Platts and Western Gulf of Maine data. Percentage of total pounds is in parentheses.

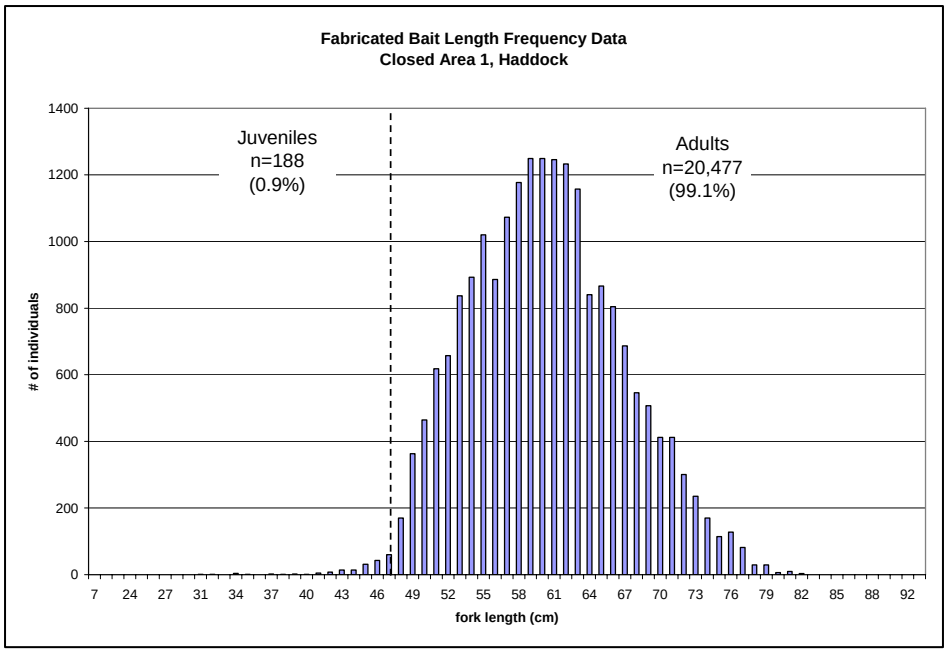
	Cod Landed, lbs	Cod CPUE	Cod Discard, lbs	Discard CPUE
Georges Bank	2,633 (58.3%)	0.0090	64 (7.5%)	0.0002
Gulf of Maine	1,886 (41.7%)	0.0211	792 (92.5%)	0.0089

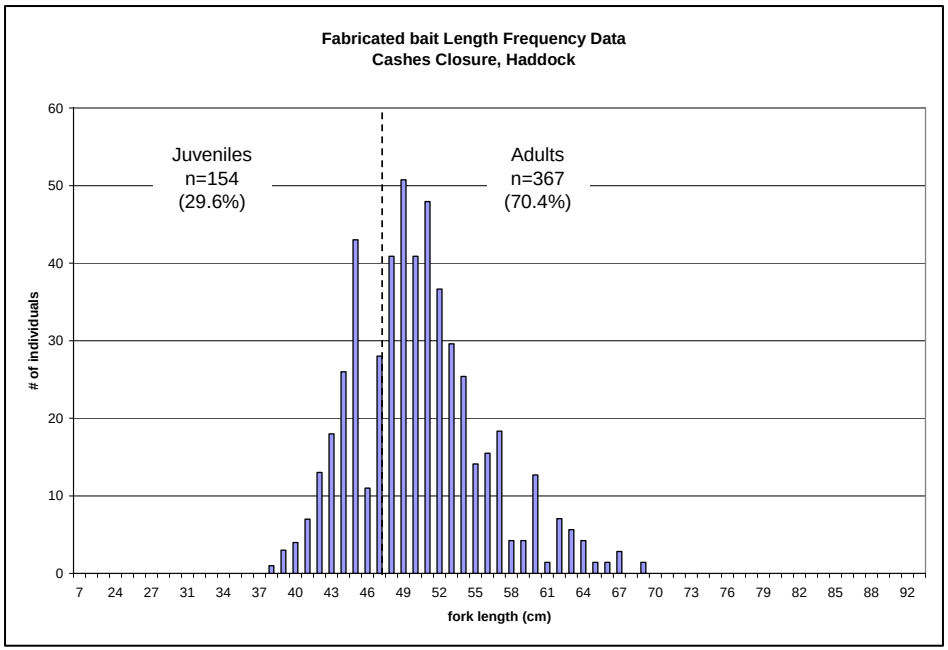
Table 6: Breakdown of cod landed and discarded by general area, recorded in pounds and pounds per hook (CPUE). Georges Bank includes Closed Area I and EUSCA data. Gulf of Maine includes Cashes Ledge, Platts and Western Gulf of Maine data. Percentage of total pounds is in parentheses.

	Haddock Landed, lbs	Haddock CPUE	Haddock Discard, lbs	Discard CPUE
Georges Bank	268,834 (90.5%)	0.9225	2,149 (54.2%)	0.0074
Gulf of Maine	28,247 (9.5%)	0.3163	1,814 (45.8%)	0.0203

Table 7: Breakdown of haddock landed and discarded by general area, recorded in pounds and pounds per hook (CPUE). Georges Bank includes Closed Area I and EUSCA data. Gulf of Maine includes Cashes Ledge, Platts and Western Gulf of Maine data. Percentage of total pounds is in parentheses.







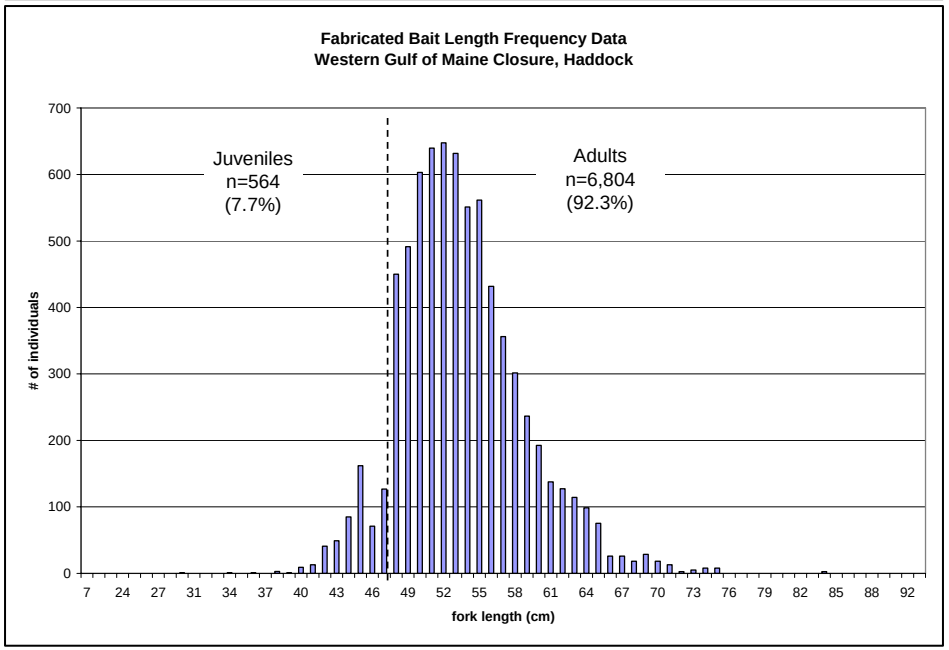
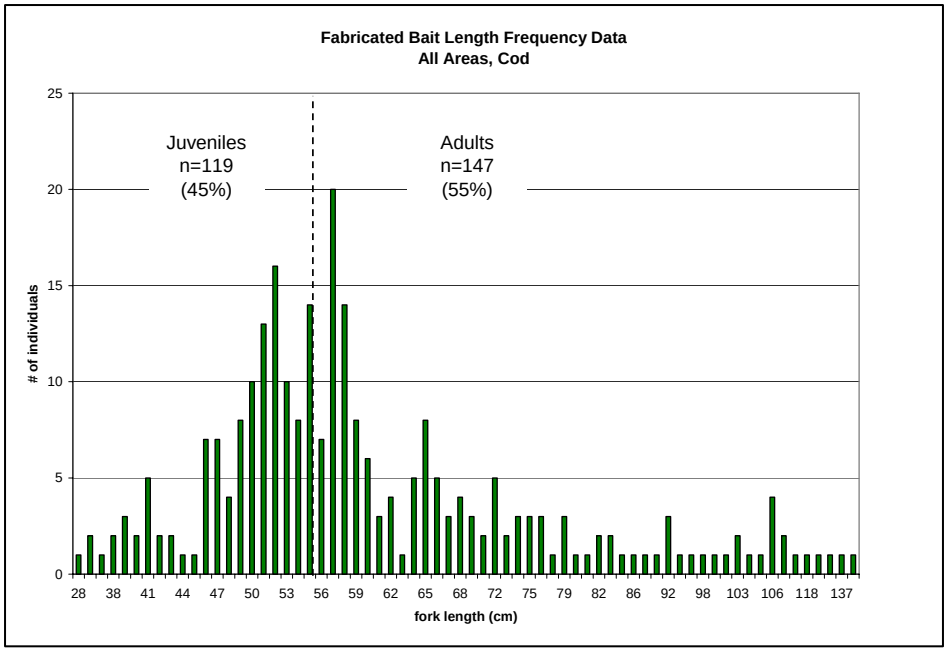
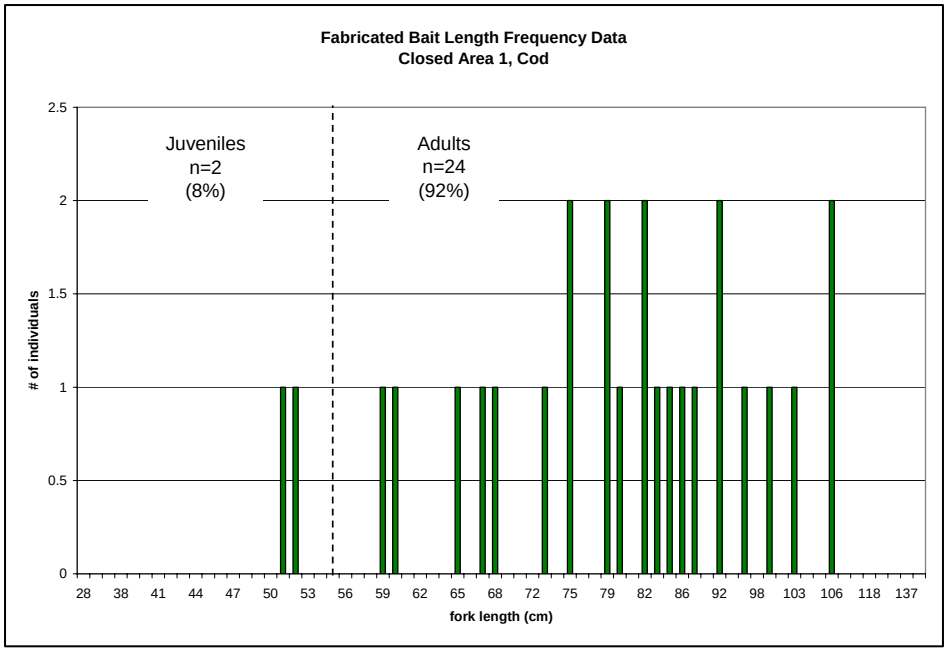
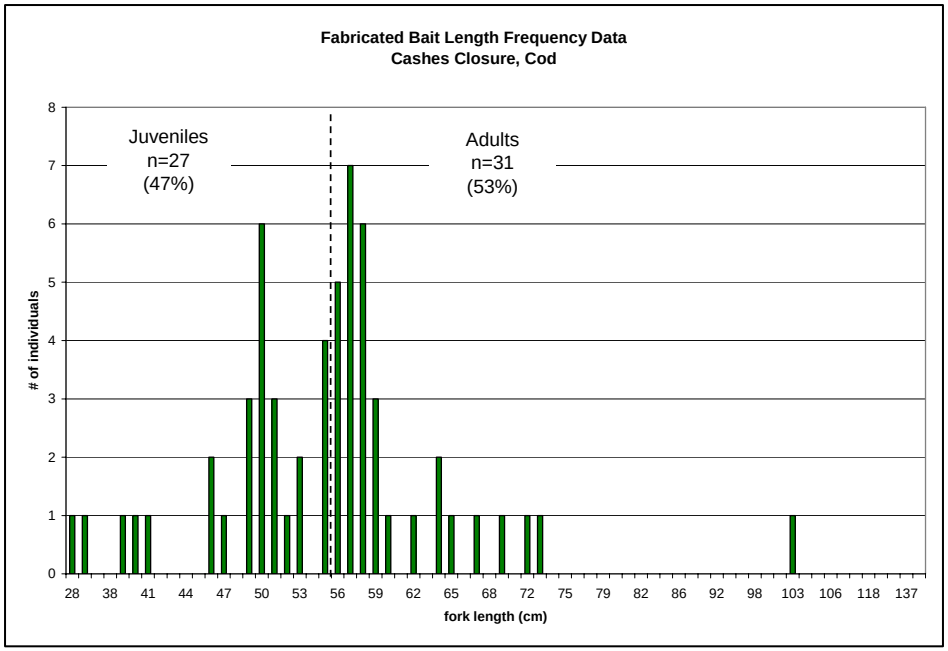


Figure 2: Haddock Length Frequency Data from Fabricated Bait Hauls. 100% sublegal haddock were measured, but only 33% of legal haddock were measured; the measured legal haddock length frequency data was extrapolated to illustrate the actual number of haddock caught. Dashed vertical line on the haddock graph indicates minimum commercial size (Total Length 19" = 48cm). Note: Cashes Closure represents a single trip.







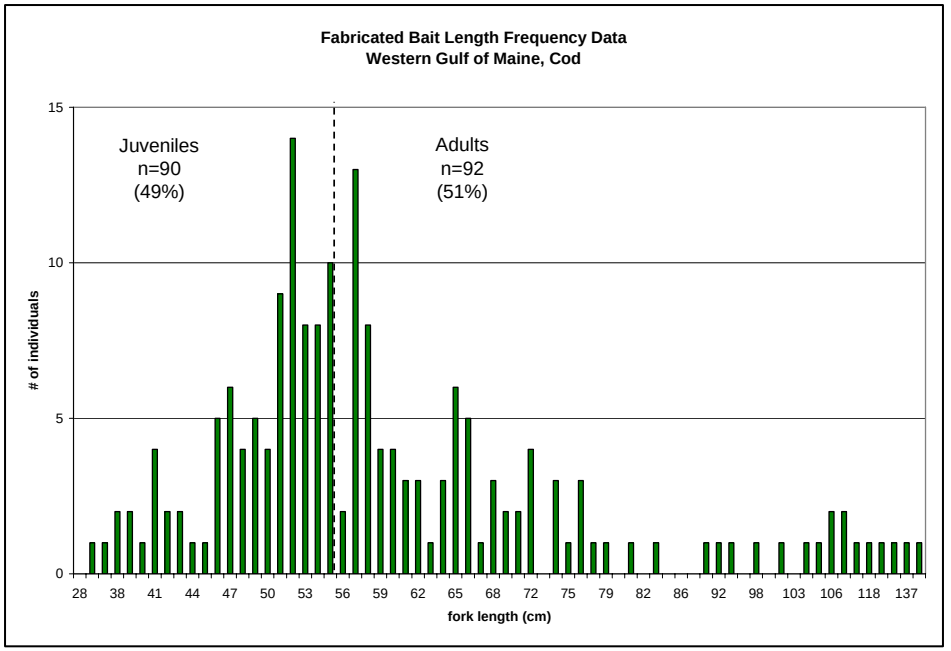


Figure 3: Cod Length Frequency Data from Fabricated Bait Hauls. All legal and sublegal cod were measured. Dashed vertical line on the cod graph indicates minimum commercial size (Total length 22" = 56cm). Note: Cashes Closure represents a single trip.

Trip by Trip Results

Descriptive statistics of haddock and cod total catch weight and catch per unit effort are detailed in Tables 8 and 9. The statistics look at all of the experimental trips, separated by Gulf of Maine and Georges Bank regions. For the purpose of this analysis, each sample equals one trip. The fishing effort on each trip varied greatly, as shown by the range of hook#: 13,026 in the Gulf of Maine and 29,717 in Georges Bank. Both regions display CPUEs of haddock and cod that are significantly different at the 95% significance level. In Gulf of Maine, cod CPUE (0.051) does not fall within the 95% confidence interval for haddock CPUE (0.361, 0.945). In Georges Bank, cod CPUE (0.007) does not fall within the 95% confidence interval for haddock CPUE (0.910, 1.224).

Gulf of Maine	*Hook #*	*Haddock CPUE*	*Cod CPUE*	*Haddock lbs*	*Cod lbs*
Mean	5953.80	0.6528	0.0512	2004.0	178.5
Standard Error	1185.94	0.1490	0.0107	323.4	34.1
Median	5450.00	0.3555	0.0465	1792.2	142.0
Mode	-	-	-	-	-
Standard Deviation	4593.13	0.5771	0.0414	1252.7	132.0
Range	13026.00	1.4723	0.1251	4789.9	524.9
Minimum	1324.00	0.0789	0.0046	311.3	18.0
Maximum	14350.00	1.5512	0.1297	5101.2	542.9
Count	15	15	15	15	15

Table 8: Descriptive summary of trip by trip Gulf of Maine data for cod and haddock. Total pounds caught were recorded in round weight. CPUE is pounds of fish per hook. Gulf of Maine includes Cashes Ledge, Platts and Western Gulf of Maine data.

Georges Bank	*Hook #*	*Haddock CPUE*	*Cod CPUE*	*Haddock lbs*	*Cod lbs*
Mean	5203.80	1.0667	0.0069	4,839.0	48.2
Standard Error	716.62	0.0801	0.0013	461.2	13.5
Median	4168.50	1.0435	0.0029	4,431.1	11.0
Mode	4500.00	-	0.0000	-	0.0
Standard Deviation	5362.72	0.5995	0.0094	3,451.5	101.2
Range	29717.00	2.7392	0.0401	18,065.9	612.3
Minimum	283.00	0.1205	0.0000	174.1	0.0
Maximum	30000.00	2.8596	0.0401	18,240.0	612.3
Count	56	56	56	56	56

Table 9: Descriptive summary of trip by trip Georges Bank data for cod and haddock. Total pounds caught were recorded in round weight. CPUE is pounds of fish per hook. Georges Bank includes Closed Area 1 and EUSCA data.

CONCLUSION

The data support the hypothesis that fabricated bait catches haddock with a low incidence of cod. The overall CPUE of haddock is 56 times greater than the CPUE of cod. The worst regional performance was still successful, occurring when there were not a lot of haddock in

the area: The Gulf of Maine haddock mean CPUE was 0.3366, 11.2 times greater than then cod mean CPUE of 0.0300 and significantly different at the 95% significance level. The data are especially strong on Georges Bank, where haddock mean CPUE is 150 times the cod mean CPUE (1.067 vs. 0.007) and also significantly different at the 95% significance level. Evidently, when haddock catches are low, the catch rates of cod increase. This could be attributed to less haddock in the area or possibly greater numbers of cod present. While the Gulf of Maine cod CPUE is 3.2 times the Georges Bank CPUE, it is still very low: at that rate, ten thousand hooks would only catch 300 lbs of cod.

The difference between the two areas on Georges Bank is relatively small: the cod CPUE for EUSCA is 3 times the cod CPUE for CA1; the haddock CPUE for CA1 is 2.3 times the haddock CPUE for EUSCA. Once again, when haddock CPUE is low, cod CPUE increases slightly. The areas in the Gulf of Maine show more variable data. The single trip to Platts has exceedingly low CPUEs of both cod and haddock; there may have been no fish around, but the single sample does not allow for a true conclusion. The WGOM cod CPUE is 1.5 times the Cashes CPUE and 1.7 times the EUSCA CPUE. The WGOM haddock CPUE is 2.9 times the Cashes CPUE and 1.2 times the EUSCA CPUE. While the haddock CPUEs in the Gulf of Maine are lower than Georges Bank, it may be an indication of stronger recovery and higher biomass on Georges Bank. All three areas in the Gulf of Maine indicate that haddock are more likely than cod to prefer fabricated bait, with a preference magnitude of 8 to 33 fold.

The minimum and maximum CPUEs confirm, like all fishing, the variable nature of fishes. Gulf of Maine and Georges Bank both have exceptional maximum haddock catch rates, catching 1.5 to 2.8 pounds of fish per hook. Most hook and line fishermen consider catch rates of 0.3 adequate and 0.5 good. There were also trips in both areas that had low catch rates of haddock: 0.07 to 0.12 pounds of fish per hook. The fabricated bait never failed to catch any haddock. Cod catch rates for the two areas had extraordinary minimums: many trips had zero cod, up to 0.0046 pounds per hook. The maximum cod catch rates are acceptable, catching 0.04 to 0.13 pound of fish per hook. The highest maximum rate, 0.13, was on a trip that also had a high haddock CPUE, 1.4, possibly indicating a time or place where catch rates are high regardless of species. The catch rates are variable, as there was a range of effort used throughout the experiment; the only calculable mode is zero for cod pounds and CPUE. All of the data comparing Georges Bank and Gulf of Maine do need to be considered in light of sample size: there were 56 trips and 291,413 hooks in Georges Bank and only 15 trips and 89,307 hooks in the Gulf of Maine. A few trips to the Gulf of Maine that caught an above average amount of cod could have easily skewed the overall CPUE since they accounted for approximately one sixth of the dataset.

Additionally, the fabricated bait does not result in many discarded fish. When corrected for effort, haddock discards are 1% of the total haddock caught (lbs). For cod, the discards account for 16% of the total cod caught (lbs). Discarded sublegal fish represent a subset of the total discards. Calculated with numbers of fish from the length frequency data, cod sublegals accounted for 45% of the total cod, and haddock sublegals accounted for 3.2% of the total haddock. Preliminary reports indicate that many of the discarded sublegal cod survive the release process (Rudolph, 2005). The amount of sublegal fish is most likely smaller than the numbers reported through length frequencies; the fish lengths were classified as sublegal based

on fishing regulations (56 cm for cod and 48 cm for haddock) measured in total length (TL), even though the measurement taken was fork length (FL) (Figures 2 and 3). This discrepancy could result in a 47cm (FL) haddock being classified as sublegal (less than 48cm, TL), when in reality, if measured to total length, it would most likely be a legal fish. The data were not corrected for this potential over-reporting of sublegal fish.

DISCUSSION

The results of this study substantiate the ability of fabricated bait to catch significantly more haddock than cod. Ideally, the study would have a control of other baits as a side by side comparison with the fabricated baits. However, the federally issued experimental fishing permit that allowed the research to occur did not allow for enough cod to be caught to create a control. If squid and herring had been used throughout the course of the study as controls, the experiment would have ended after a few trips as a result of exceeding the low cod caps set by the permit. For the permit in EUSCA, fabricated bait was the only bait allowed, preventing any type of control.

An indirect comparison of the fabricated bait data to Rudolph's (2004) squid and herring data shows that the squid and herring have, respectively, a total cod CPUE 9.3 and 4.3 times greater than the fabricated bait. The fabricated bait caught 56 times more haddock than cod, while the squid and herring only caught 12 and 22 times more haddock than cod, respectively.

We can at least verify that cod was present in the EUSCA area while our experiment occurred. National Marine Fisheries Service (NMFS) has been monitoring haddock and cod landings for all gear types in the EUSCA through vessel reporting and observer coverage. For the time period that corresponds to our EUSCA trips (June 2 - July 14, 2005), NMFS reports 170,042 and 674,780 for the cumulative reported total pounds caught of cod and haddock, respectively (NOAA, 2005). This is a 4-fold difference in cod and haddock. Our experimental trips caught a total of 1,772 lbs of cod and 60,203 lbs of haddock, a 34-fold difference. The 170,042 pounds of cod caught in the area confirms the presence of cod during our experimental fabricated bait sets.

Additionally, the Northeast Fishery Science Center indicates the 2002 biomasses of haddock and cod on Georges Bank have a 4:1 ratio (Brodziak, 2005). The fabricated bait CPUE ratios for Georges Bank show that haddock is, on average, 154 times more likely to take the bait than cod. If the bait was not selecting for haddock, the ratios should be closer to 4:1; instead, the haddock is showing a clear preference for the fabricated bait.

The verification of fabricated bait's success at selectively targeting haddock has a range of implications for fisheries management and fishing businesses, from facilitating rebuilding of species to creating new fishing opportunities.

New England groundfish are managed as a multispecies fishery and the ability to selectively target a single species prevents overfishing of depleted stocks within the fishery. In the case of Norbait, the fisherman can minimize mortality on cod while still targeting haddock. Currently,

the Norbait is being successfully used by hook and line groundfishermen to catch haddock as a part of their regular fishing practices.

Selective targeting also creates management opportunities that allow stocks of concern to recover while landing healthy species. Current fishery management regulations (Amendment 13) strive to end overfishing of groundfish stocks in the long term, but have short-term social and economic costs for the New England groundfish fleet. Implementation of special access programs (SAPs) provide a way to mitigate some of these costs. SAPs provide for the creation of strictly managed, temporary fisheries targeting recovered or healthy fish stocks. Fishermen pay the majority of the costs associated with restricted management regulations and SAPs allow the fishermen to recoup these costs when their sacrifices have led to healthy stocks. Critical to SAP implementation is the ability to avoid overfished stocks during fishing.

The initial data collected in this experiment have already been used to support and implement a SAP fishery in Closed Area I for hook and line caught haddock. The initial results from the CA1 experimental fabricated bait trips provided data in support of the fishermen's ability to target haddock without impacting the recovering cod stock. The 2004 SAP was a success, landing 1,041,127 pounds of haddock and 20,265 pounds of cod (2% of catch), and will continue in 2005. The opportunity to participate in an SAP saved a large portion of the Lower Cape hook and line vessels from going out of business; thus, preserving the historic community of dayboat fishermen in New England.

The assurance of minimal mortality on cod provides leverage for future haddock research projects. Experiments to measure discard mortality, movement patterns, and other life history traits can proceed without apprehension over impacts on the rebuilding process for cod. This leverage has already been illustrated through the development and successful implementation of the Northeast Consortium Cooperative Haddock Tagging Program. The tagging program uses Norbait to selectively fish for haddock inside and outside of fishery closures.

Fabricated bait derived from herring has been shown to successfully target haddock while barely catching cod. The success of this experiment offers the potential for interested parties to develop new fabricated baits that selectively target other commercial species. The creation of extremely selective fishing gear has the potential to assist fishery managers in ending overfishing and rebuilding the fisheries in New England and around the country.

LITERATURE CITED

Bjordal, A. & S. Lokkeborg, 1996. Longlining. Fishing News Books, Cambridge, MA.

Brodziak, J., Thompson, M., and R. Brown, 2002. Section 2: Stock Assessments-B. Georges Bank Haddock. *In* Assessement of 20 Northeast Groundfish Stocks through 2001, *A report of the groundfish assessment review meeting (GARM), Northeast Fisheries Science Center*, Woods Hole, Massachusetts, October 8-11, 2002. Available online http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0216/0216.2b.pdf, 10-Aug-2005.

Brodziak, J., 2005. Personal communication; provided document entitled *Updated Groundfish Stock Status, October 2003*. 10-Aug-2005.

Brown, B. and R. Hennemuth, 1971. Length-weight relations of haddock from commercial landings in New England, 1931-1955. NOAA Tech. Rep. NMFS SSF-638.

Federal Register, 1995. Northeast Multispecies Fishery; Framework 9. 60 CFR 19364.

Lokkeborg, S. & A. Bjordal, 1992. Species and size selectivity in longline fishing: a review. Fish. Res., 13: 311-322.

NEFSC, 2004. Haddock Baby Boom Detected on Georges Bank, NMFS Northeast Fisheries Science Center News. Available online http://www.nefsc.noaa.gov/press_release/2004/news04.02.html, 15-Aug-2005.

NOAA, 2005. US/Canada Resource Sharing Monitoring: Fishery Analysis & Monitoring Section: 2005-2006 Fishing Year. Available online: http://www.nero.noaa.gov/ro/fso/usc.htm, 20-Aug-2005.

Norbait DA, 2005. Norbait DA- Fishbait for the Future. Available online: http://www.norbait.com/, 29 June 2005.

Rudolph, T., 2004. Georges Bank Hook Sector Closed Area 1 Special Access Program (SAP). White paper, Cape Cod Commercial Hook Fishermen's Association.

Rudolph, T., 2005. Preliminary results of: Survival of Sub-legal Atlantic Cod (Gadus morhua) in the Northwest Atlantic Longline Fishery. Northeast Consortium Annual Report, June 2005.

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