

**A Collaborative Program to Test the use of a  
Cod/haddock Separator Panel in Trawl Nets**

SFC APPROVED	
BY	DMK
DATE	3/20/06

Final Report submitted to:  
Northeast Regional Office  
National Marine Fisheries Service  
Cooperative Research Partners Initiative  
Attention Nick Anderson  
One Blackburn Drive  
Gloucester, MA 01930-2298

EA133F - 02 - CN - 0038

Submitted by: 9/23/02 - 3/31/05

Captain John D. Raymond, Fishing Vessel Olympia,  
PO Box 287  
S. Berwick, ME 03908

and

Manomet Center for Conservation Sciences  
PO Box 1770  
Manomet, MA 02345



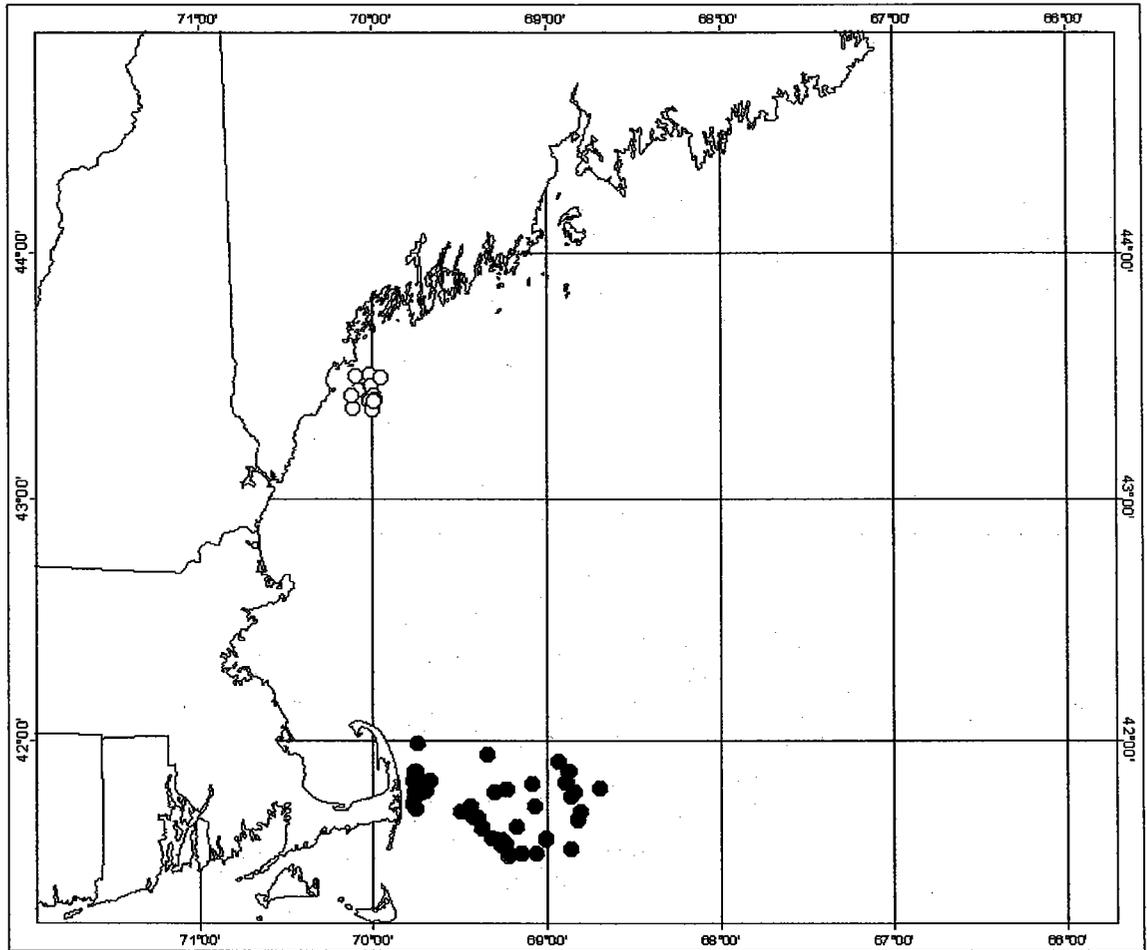


Figure 3. Distribution of fishing trials by fishing vessel. Most fishing trials were conducted east of Cape Cod, while fishing vessel North Star fished east of Portland. These fishing areas were considered by industry partners to afford optimum probability of encountering commingled cod and haddock stocks.

The cod/haddock separator nets were tested during the months of May and June 2003, when a total of 8 trips were dedicated exclusively to this project (Table I). Of these, 2 were multi-day trips taken on large vessels, for a total of 40 valid hauls; the other 6 were day-trips taken on smaller vessels, which collectively yielded 22 hauls. Figure 3 shows distribution of fishing effort during experimental seat trials. Location of fishing grounds were determined by individual fishing captains on basis of known fishing grounds and historical knowledge of co-existence of both cod and haddock.

**Table 1.**

Trip duration	Vessel size	No. of trips	No. of hauls
Multi-day	large	2	40
Single day	small	6	22

The degree of separation between upper and lower codends was determined for each species on each haul and on overall catch and by length class and by weight and number of individuals. Full NMFS sea sampling protocols were employed and all sampling was conducted by observers certified to NMFS standards. Raw data can be made available to NMFS on paper and in electronic format on request.

Because of potential differences between fishing operations in large and small vessels, in the first part of the analysis data were analyzed separately for the two types of vessels. In the second part, data were pooled when and where deemed appropriate.

## **Results**

Table IIa shows the catch distribution between the top and bottom codend, in large and small vessels and pooled for all the vessels. For each species caught, the table shows the weight, in lbs., and, for the commercially important species measured individually, the number of individuals found in each codend. Table IIb shows a summary of catch distribution (weight and number of individuals) for the two key species (cod and haddock) by vessel.

**Table Ia** Catch distribution (weight and number of individuals) by species and vessel.

FISH SPECIES	LARGE VESSELS				SMALL VESSELS				POOLED VESSELS			
	LBS		NUMBER		LBS		NUMBER		LBS		NUMBER	
	top	bottom	top	bottom	top	bottom	top	bottom	top	bottom	top	bottom
Cod	1667	9306	166	951	3919.5	11689.5	311	831	5586.5	20995.5	477	1778
Dab	8.5	318.5	8	408	8.3	926	21	748	16.8	1244.5	29	1108
Grey sole	45	1290.3	48	1627	0	33.3	0	29	45	1323.6	48	1653
Haddock	397.3	597.5	75	136	159.5	207	44	61	556.8	804.5	119	197
Hake, red	0	7.8	0	na	1	48.5	na	na	1	56.3	na	na
Hake, silver	0.5	18.41	na	na	1	10.5	na	na	1.5	28.91	na	na
Hake, white	8	356.3	na	na	0	0	0	0	8	356.3	na	na
Herring	0	19.4	0	na	1	1.6	na	na	1	21	na	na
Lobster	0	689.8	0	na	0	147.5	0	na	0	837.3	0	na
Monkfish	174	2943.8	45	785	11	1019	6	459	185	3962.8	51	1243
Ocean pout	0	9.05	0	na	0	15	0	na	0	24.05	0	na
Pollock	1129	2254	113	326	7	8	1	1	1136	2262	114	325
Redfish	178.5	407	na	na	3	0.5	na	na	181.5	407.5	na	na
Sculpin	0	7.8	na	na	1	48.5	na	na	1	56.3	na	na
Searaven	2	662	na	na	4.5	687.5	na	na	6.5	1349.5	na	na
Skate, nk	259	3847.5	na	na	78.5	1240.5	na	na	337.5	5088	na	na
Sp. dogfish	17	882	na	na	0	15.5	0	na	17	897.5	na	na
Wolfish	9.5	643.5	na	na	8	120	na	na	17.5	763.5	na	na

**Table Ib** Summary of catch distribution (weight and number of individuals) for the two key species (cod and haddock) by vessel category.

FISH SPECIES	LARGE VESSELS				SMALL VESSELS				ALL VESSELS			
	LBS		NUMBER		LBS		NUMBER		LBS		NUMBER	
	top	bottom	top	bottom	top	bottom	top	bottom	top	bottom	top	bottom
Cod	1667	9306	166	951	3919.5	11689.5	311	831	5586.5	20995.5	477	1778
	15%	85%	15%	85%	25%	75%	27%	73%	21%	79%	21%	79%
Haddock	397.3	597.5	75	136	159.5	207	44	61	556.8	804.5	119	197
	40%	60%	36%	64%	44%	56%	42%	58%	41%	59%	38%	62%

Taking haul by haul data, for each species, the distribution of fish between top and bottom codends was compared. The overall frequency with which each species were observed in the top or bottom or both codends was compared using chi-square analysis. The purpose of this test was to determine whether any given species was represented only in one or other codend or whether individuals tended to be represented in both codends on any given haul. For the species for which a significant chi-square test result is shown, the last column shows the codend it most frequently is represented in (here referred to as "favored" codend). Note that when a statistical difference is apparent, the so called "favored" codend is always the bottom codend. The results are summarized in Table III.

**Table III** Summarized results of Chi-square statistical analyses

	Large	Small	Pooled	Favored codend
Cod	ns	ns	ns	
Dab	***	**	***	Bottom
Grey sole	*	na	***	Bottom
Haddock	ns	ns	ns	
Hake, red	na	na	na	
Hake, silver	**	/*	***	Bottom
Hake, white	***	na	***	Bottom
Herring	na	ns	***	Bottom
Lobster	na	***	na	
Monkfish	**	***	***	Bottom
Ocean pout	na	na	na	
Pollock	ns	ns	ns	
Redfish	ns	ns	ns	
Sculpin	na	**	***	Bottom
Searaven	***	**	***	Bottom
Skate, nk	***	**	***	Bottom
Sp. dogfish	***	ns	***	Bottom
Wolfish	***	*	***	Bottom

It is clear from Table III that, some species (e.g. dab, monkfish, skates and monkfish) are significantly more likely to be found in only one codend than to be found in both codends during an individual tow. Other species such as cod, haddock and pollock are more likely to be represented in both codends during a single tow. This test does not test for the quantity of fish in either codend merely presence or absence

The data were then explored using the non-parametric Sign Test to test for statistical difference in the size (quantity in lbs.) of the catch for any given species between codends. It was applied haul by haul for large and small vessels separately. The results are shown in Table IV.

**Table IV.**

	Large	Favored codend	Small	Favored codend
Cod	***	Bottom 34 vs. 2	***	Bottom 21 vs. 0
Dab	***	Bottom 33 vs. 2	***	Bottom 21 vs. 1
Grey sole	***	Bottom 34 vs. 6	***	Bottom 14 vs. 0
Haddock	ns	Bottom 18 vs. 14	ns	Bottom 10 vs. 10
Hake, red	***	Bottom 14 vs. 0	ns	Bottom 3 vs. 0
Hake, silver	***	Bottom 17 vs. 2	/*	Bottom 5 vs. 0
Hake, white	***	Bottom 20 vs. 0	na	na
Herring	**	Bottom 10 vs. 0	ns	Bottom 3 vs. 1
Lobster	***	Bottom 33 vs. 0	***	Bottom 17 vs. 0
Monkfish	***	Bottom 34 vs. 5	***	Bottom 22 vs. 0
Ocean pout	***	Bottom 14 vs. 0	/*	Bottom 5 vs. 0
Pollock	***	Bottom 27 vs. 7	ns	Bottom 1 vs. 1
Redfish	**	Bottom 24 vs. 7	ns	Bottom 1 vs. 1
Sculpin	/*	Bottom 5 vs. 0	***	Bottom 12 vs. 0
Searaven	***	Bottom 31 vs. 1	***	Bottom 17 vs. 0
Skate, nk	***	Bottom 35 vs. 4	***	Bottom 23 vs. 1
Sp. dogfish	***	Bottom 26 vs. 0	ns	Bottom 3 vs. 0
Wolfish	***	Bottom 19 vs. 1	**	Bottom 8 vs. 0

## **Appendix 2**

Confidential Final Report submitted to the NOAA/NMFS CRPI  
 Not to be cited without permission

All vessels				
Catch (lbs)				
<u>TOP CODEND</u>				
SPECIES	MEAN	STD. ERROR	STANDARD DEVIANCE	VARIANCE
Cod	133.01	43.65	282.89	80024.29
Dab	1.29	0.28	1.02	1.04
Grey Sole	2.65	0.62	2.54	6.46
Haddock	14.28	2.04	12.77	163.07
hake, silver	0.50	0.25	0.44	0.19
hake, white	8.00	na	na	na
Herring	1.00	na	na	na
Monkfish	11.24	2.79	11.49	132.03
Pollock	32.62	6.34	34.13	1164.65
Redfish	7.58	2.16	10.80	116.60
Sculpin	1.00	na	na	na
Sea Raven	1.63	0.24	0.48	0.23
Skate, NK	21.09	10.26	41.02	1682.67
Spiny Dogfish	4.25	1.03	2.06	4.25
Wolfish	8.75	0.75	1.06	1.13

All vessels				
Catch (lbs)				
<u>BOTTOM CODEND</u>				
SPECIES	MEAN	STD. ERROR	STANDARD DEVIANCE	VARIANCE
Cod	368.31	76.81	574.79	330387.61
Dab	23.04	4.63	34.02	1157.14
Grey Sole	27.58	5.62	38.97	1518.59
Haddock	20.11	3.14	19.83	393.25
Hake, red	2.69	0.46	1.90	3.62
Hake, silver	1.26	0.26	1.24	1.55
Hake, white	17.82	4.72	21.11	445.53
Herring	1.62	0.69	2.50	6.24
Lobster	16.75	2.07	14.64	214.41
Monkfish	69.52	8.13	61.35	3763.33
Ocean Pout	5.55	1.02	4.46	19.86
Pollock	85.10	16.46	88.65	7858.02
Redfish	12.73	3.44	19.44	377.89
Sculpin	3.31	0.81	3.32	11.04
Sea Raven	28.11	4.25	29.43	865.87
Skate, NK	86.24	15.94	122.43	14989.24
Spiny Dogfish	30.95	8.03	43.24	1870.06
Wolfish	29.43	4.32	22.44	503.59
Yellowtail Fl.	2.11	0.63	1.88	3.55

Confidential Final Report submitted to the NOAA/NMFS CRPI  
 Not to be cited without permission

<b>All vessels</b>				
<b>Catch (number of individuals)</b>	<b>TOP CODEND</b>			
	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIANCE</b>	<b>VARIANCE</b>
monkfish	3.19	0.53	2.14	4.56
cod	11.09	2.48	16.28	264.90
gray sole	2.82	0.61	2.51	6.28
dab	2.42	1.05	3.63	13.17
haddock	3.05	0.48	2.97	8.84
pollock	3.93	0.81	4.35	18.92

<b>All vessels</b>				
<b>Catch (number of individuals)</b>	<b>BOTTOM CODEND</b>			
	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIANCE</b>	<b>VARIANCE</b>
monkfish	21.45	2.47	18.82	354.25
cod	31.82	3.87	28.95	838.08
gray sole	33.80	6.43	44.98	2023.25
dab	20.28	3.20	24.14	582.78
haddock	4.80	0.71	4.56	20.81
pollock	11.28	2.47	13.31	177.06

Confidential Final Report submitted to the NOAA/NMFS CRPI  
 Not to be cited without permission

<b>Large vessels</b>				
<b>Catch (number of individuals)</b>				
		<b>TOP CODEND</b>		
<b>SPECIES</b>	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIANCE</b>	<b>VARIANCE</b>
monkfish	3.21	0.58	2.15	4.64
cod	6.38	1.08	5.49	30.09
gray sole	2.82	0.61	2.51	6.28
dab	1.00	0.00	0.00	0.00
haddock	3.13	0.56	2.76	7.59
pollock	4.04	0.83	4.39	19.29
<b>Catch (number of individuals)</b>		<b>BOTTOM CODEND</b>		
<b>SPECIES</b>	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIANCE</b>	<b>VARIANCE</b>
monkfish	21.81	2.89	17.31	299.76
cod	27.17	3.73	22.08	487.44
gray sole	45.19	7.94	47.64	2269.70
dab	11.33	1.44	8.66	75.03
haddock	5.67	1.05	5.13	26.32
pollock	11.64	2.53	13.40	179.57

Confidential Final Report submitted to the NOAA/NMFS CRPI  
 Not to be cited without permission

<b>Small vessels</b>				
<b>Catch (number of individuals)</b>				
		<b>TOP CODEND</b>		
<b>SPECIES</b>	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIANCE</b>	<b>VARIANCE</b>
monkfish	3.00	2.00	2.83	8.00
cod	18.29	5.73	23.61	557.22
gray sole	na	na	na	na
dab	5.25	2.84	5.68	32.25
haddock	2.93	0.88	3.39	11.50
pollock	1.00	na	na	na

<b>Small vessels</b>				
<b>Catch (number of individuals)</b>				
		<b>BOTTOM CODEND</b>		
<b>SPECIES</b>	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIANCE</b>	<b>VARIANCE</b>
monkfish	20.86	4.58	21.48	461.36
cod	39.57	8.09	37.08	1375.16
gray sole	2.23	0.54	1.96	3.86
dab	35.62	7.27	33.31	1109.35
haddock	3.59	0.82	3.39	11.51
pollock	1.00	na	na	na

Confidential Final Report submitted to the NOAA/NMFS CRPI  
 Not to be cited without permission

<b>Large vessels</b>				
<b>Catch (lbs)</b>		<b>TOP CODEND</b>		
<b>SPECIES</b>	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIATION</b>	<b>VARIANCE</b>
Cod	66.68	12.49	62.46	3901.00
Dab	1.06	0.25	0.72	0.51
Grey Sole	2.65	0.62	2.54	6.46
Haddock	15.89	2.73	13.65	186.44
hake, silver	0.25	0.05	0.07	0.01
hake, white	8.00	NA	NA	NA
Monkfish	12.00	3.10	11.99	143.82
Pollock	33.54	6.50	34.39	1182.61
Redfish	7.77	2.24	10.99	120.72
Sea Raven	2.00	NA	NA	NA
Skate, NK	25.90	16.43	51.96	2700.10
Spiny Dogfish	4.25	1.03	2.06	4.25
Wolfish	9.50	NA	NA	NA

<b>Large Vessels Catch (lbs)</b>				
		<b>BOTTOM CODEND</b>		
<b>SPECIES</b>	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIATION</b>	<b>VARIANCE</b>
Cod	255.31	32.24	190.74	36383.65
Dab	9.64	1.19	6.81	46.40
Grey Sole	37.95	7.24	42.19	1780.37
Haddock	25.98	4.75	22.78	518.92
hake, red	2.49	0.53	1.99	3.95
hake, silver	1.08	0.30	1.23	1.51
hake, white	17.82	4.72	21.11	445.53
herring	1.94	0.88	2.79	7.76
Lobster	20.90	2.72	15.65	244.91
Monkfish	84.11	10.67	63.13	3985.14
Ocean Pout	6.46	1.26	4.73	22.40
Pollock	87.86	16.82	89.00	7921.02
Redfish	13.13	3.53	19.63	385.33
sculpin	1.56	0.68	1.51	2.29
Sea Raven	21.35	3.03	16.87	284.55
Skate, NK	106.88	24.91	149.44	22331.51
Spiny Dogfish	33.92	8.78	44.78	2005.37
Wolfish	33.87	5.64	24.57	603.52
Yellowtail FI	3.50	3.00	4.24	18.00

Confidential Final Report submitted to the NOAA/NMFS CRPI  
 Not to be cited without permission

<b>Small vessels</b>				
<b>Catch (lbs)</b>		<b>TOP CODEND</b>		
<b>SPECIES</b>	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIATION</b>	<b>VARIANCE</b>
Cod	230.56	103.53	426.88	182225.75
Dab	1.66	0.62	1.40	1.95
Haddock	11.39	2.91	10.89	118.51
Monkfish	5.50	3.50	4.95	24.50
Skate, NK	13.08	3.28	8.04	64.64
Wolfish	8.00	na	na	na

<b>Small vessels</b>				
<b>Catch (lbs)</b>		<b>BOTTOM CODEND</b>		
<b>SPECIES</b>	<b>MEAN</b>	<b>STD. ERROR</b>	<b>STANDARD DEVIATION</b>	<b>VARIANCE</b>
Cod	556.64	193.60	887.20	787126.93
Dab	44.10	10.31	47.23	2230.52
Grey Sole	2.38	0.64	2.38	5.68
Haddock	12.18	2.75	11.34	128.65
herring	0.53	0.26	0.45	0.20
Lobster	8.68	1.91	7.87	61.97
Monkfish	46.32	11.01	51.62	2664.75
Redfish	0.50	na	na	na
sculpin	4.04	1.05	3.64	13.25
Sea Raven	40.44	10.17	41.95	1760.00
Skate, NK	53.93	9.78	46.92	2201.87
Wolfish	18.88	4.15	11.74	137.77
Yellowtail FI	1.71	0.36	0.95	0.90