APPENDIX A2: Supplemental "Transect" Survey. General information regarding silver hake in the Supplemental "Transect" Survey carried out cooperatively by Industry and the Haskin Shellfish Research Laboratory in Bivalve, NJ. Some calculations (e.g. for "swath areas") were not discussed by the Joint Working Group or used in the assessment for silver hake.

Summary of results for whiting from the Supplemental Finfish Survey Targeting Mid-Atlantic Migratory Species: March 2003 – May 2005

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To date, nine Supplemental Finfish Surveys have been completed. Surveys took place on the F/V Jason & Danielle during the weeks of March 8-12, 2003, May 25-31, 2003, January 24-February 2, 2004, March 4-17, 2004, and May 19-23, 2004. During the weeks of November 15-21, 2004, January 10-22, March 13-23, and May 4-10, 2005 the survey was conducted on the F/V Luke & Sarah. Two transects located near Hudson and Baltimore Canyon were sampled during every survey effort. A transect near Poor Man's Canyon was sampled during March of 2004 and 2005 and in March of 2005, a transect was sampled near Alvin Canyon (Figure 1). The survey gear, including net, sweep and doors were transferred from the original survey vessel and have remained constant throughout the survey. In November 2004, two new codends were built by the same company and to the same specifications as those used during previous surveys.

To obtain a relative index of silver hake, *Merluccius bilinearis*, from the Supplemental Finfish Surveys Targeting Mid-Atlantic Migratory Species, all calculations have been adjusted to swath area. Swath area measures the relative importance of each sampled depth according to its contribution to total distance along the transect line set perpendicular to the depth contour. Figure 2 shows an example of how the distance along the transect line was allocated to each tow for the calculation of swath area. The calculation projects the swept area of the tow had the net been towed continuously down slope along the transect line, from the shallowest to deepest station, for the distance allocated to each sample depth. This distance is established by the midpoints between perpendiculars dropped to the transect line from the midpoints of each tow (Figure 2).

During the March 2003 survey, silver and offshore hake were not separated and thus, the March 2003 data were excluded from this synopsis. Since the Poor Man's and Alvin Canyon transects were not sampled during every survey effort, data from these transects were also excluded.

Cross-Shelf Biomass By Transect and Survey

The highest overall cross-shelf projected biomasses were observed during March of 2005 along the Hudson and Baltimore Canyon transects. The survey consistently caught, in biomass and abundance, more whiting along Hudson Canyon transect than Baltimore Canyon transect (Tables 1 & 2 and Figure 3).

Swath Projected Biomass By Depth

In order to understand how whiting are distributed both spatially and temporally, the data are broken down by transect, by survey, and by depth. A comparison of depth changes for the 20^{th}, 50^{th}, and 80^{th} percentiles of cumulative catch on each transect is plotted in Figure 4. The 50^{th} percentile, for example, is the depth where the cumulative catch curve reached 50% of the total catch and the 20^{th} and 80^{th} percentiles are confidence interval bands, where cumulative catch reached 20% and 80% of the total catch. Observations show that silver hake are widely distributed across the shelf but are caught most frequently at depths ranging from 80 to 350 m on the Hudson and Baltimore Canyon transects. Whiting are caught as deep as 457 m, the deepest station, though catches tend to be smaller and less frequent at these depths (Table 3 and Figure 4). It is likely that the survey misses a small percentage of the inshore portion of the stock during some surveys. Instances include all of the surveys, but most notably May 2003 (Baltimore), May 2004 (Hudson and Baltimore) (Table 3). Also noteworthy, is the fact that the whiting catches occurred in deeper water more frequently in 2005 than in 2003 and 2004, and it is likely that the survey also misses a small percentage of the offshore portion of the stock.

Silver hake appear to make seasonal inshore/offshore migrations and the population tends to be situated further offshore on the Baltimore Canyon transect than the Hudson Canyon transect (Figure 4). Generally, silver hake are narrowly distributed inshore during the spring surveys (May 2003, 2004, 2005) and migrate further offshore, spreading out over the shelf, during the winter months (March and November 2004 and January 2005). Along the Hudson and Baltimore Canyon transects during the May 2003 and 2004 surveys, silver hake tended to be

most abundant at depths ranging 80-130 m. They spread out over the shelf and move into deeper water during the winter surveys. For example, 60% of the whiting caught along the Hudson Canyon transect occurred at depths of 90-180 m during March 2004, and 210-325 m, in January 2005. Along Baltimore Canyon transect, 60% of the whiting caught occurred at depths ranging from 110-260 m, in March 2004 and 270-360 m, in January 2005 (Figure 4).

Cross Shelf Numbers Per Size Class By Transect and Survey

The size of silver hake caught ranged from 19-52 cm during the March 2004 and 2005 supplemental surveys (Table 4 and Figure 5). More than 95% of the whiting measured during the March surveys ranged from 21-34 cm.

Length-Weight Relationship By Transect and Survey

The von Bertalanffy equation for isometric growth is: $W = a\sum L^b$, where W=weight, L=length, b=3, and a is a constant. The length-weight relationships observed for whiting are consistent with this equation and the growth exponent, b, ranged from 3.23-3.30, and R^2 values fell between 68-85% (Figure 6).

Median Size Class Per Depth By Transect and Survey

The 50th percentile size class was determined for each depth sampled for tows with 20 or more measured individuals (Table 5). Within a given survey, the median size of whiting does not appear to vary with depth. In a given survey, the median size of whiting caught on the Baltimore Canyon transect is, on average, 1-2 cm larger than whiting captured on Hudson Canyon transect (Table 5 and Figure 7).

Table 1 (APPENDIX A2). Swath area whiting catch (kg) per tow summed across all tows per transect. This is a theoretical number caught if the net had been towed continuously down slope from the shallowest to the deepest station along each transect.

	Hudson Canyon Transect	Baltimore Canyon Transect
May 2003	240,209.7	17,214.3
January 2004	966,929.5	96,870.9
March 2004	3,057,810.4	256,876.6
May 2004	1,184,289.6	187,153.3
November 2004	5,218,371.8	799,376.9
January 2005	3,041,186.9	499,071.9
March 2005	9,445,397.0	1,130,256.1
May 2005	5,215,401.3	625,998.6

Table 2 (APPENDIX A2). Swath area projected total abundance of measured whiting across all tows for each survey. The multiplication of these numbers and the percentages in Table 4, provide the reader with the project number of whiting per size class (March 2004 and 2005, only).

	Hudson Canyon Transect	Baltimore Canyon Transect
May 2003	1,171,783.4	76,713.8
January 2004	68,783,310.9	815,642.1
March 2004	646,675,951.2	12,803,011.3
May 2004	24,839,510.8	1,111,541.7
November 2004	4,176,326,937.9	1,211,781,610.3
January 2005	3,332,306,046.2	235,738,849.4
March 2005	14,076,324,593.3	894,659,210.2
May 2005	1,663,613,791.5	41,528,449.4

Table 3 (APPENDIX A2). Percentage of total whiting catch (kg) at each depth. Dashes represent stations that were not sampled. For each transect, the depth with highest percentage of whiting caught per transect is highlighted. H=Hudson Canyon transect, B=Baltimore Canyon transect.

Target	Mar-04		Mar-05	
Depth (m)	H	B	H	B
73.15	3.38	2.00	1.47	0.32
82.30	-	-	-	5.96
91.44	26.14	13.73	12.08	5.30
100.58	1.28	-	1.09	2.56
109.73	9.23	11.15	3.42	2.63
128.02	10.75	-	2.22	-
146.30	17.88	24.47	2.64	18.64
164.59	8.94	3.00	-	-
182.88	3.61	0.66	11.75	10.98
204.83	-	6.10	8.29	-
228.60	7.51	4.45	14.62	16.59
250.55	2.01	11.11	14.22	3.23
274.32	9.15	19.67	12.68	25.48
320.04	-	2.35	13.93	5.80
365.76	0.12	1.30	0.69	2.33
387.71	-	-	-	-
411.48	0.00	0.02	0.88	0.19
457.20	0.00	-	0.02	-

Table 4 (APPENDIX A2). Cumulative size-frequency distribution of whiting across all tows, reported as a percentage of total abundance. For each transect, the size with highest percentage of whiting caught per survey is highlighted. H=Hudson Canyon transect, B=Baltimore Canyon transect.

Length	Mar-04		Mar-05	
(cm)	H	B	H	B
18	0	0	0	0
19	0	0.001	0	0
20	0	0	0.32	0
21	0.03	0.77	3.30	0.12
22	0.64	0.41	17.47	0.90
23	1.59	0.15	29.53	4.82
24	7.62	0.76	22.59	21.85
25	15.55	3.28	14.55	30.54
26	18.76	15.52	5.82	26.77
27	14.83	19.71	4.15	7.57
28	15.41	22.51	0.85	5.02
29	8.16	13.32	0.41	0.75
30	8.29	11.52	0.15	0.85
31	3.89	3.95	0.03	0.74
32	1.09	2.42	0.02	0.01
33	1.68	2.29	0.01	0.01
34	0.80	1.20	0.13	0.0004
35	0.60	1.18	0.003	0.003
36	0.48	0.33	0.01	0.01
37	0.15	0.56	0.02	0.01
38	0.32	0.03	0.45	0.02
39	0	0.07	0.0003	0
40	0.10	0.03	0	0.001
41	0.002	0	0	0
42	0	0	0.01	0
43	0.002	0	0.17	0
44	0	0	0.01	0
45	0	0.01	0.001	0
46	0	0	0	0
47	0	0	0	0
48	0	0	0	0
49	0	0	0	0
50	0	0	0	0
51	0	0	0	0
52	0	0	0.001	0
53	0	0	0	0

Table 5 (APPENDIX A2). Dashes represent tows where less than 20 whiting were measured or station was not sampled.

Target	Mar-04		Mar-05	
Depth (m)	H	B	H	B
73.15	26.7	28.1	24.9	26.1
82.30	-	-	-	24.9
91.44	27.0	28.9	25.0	25.3
100.58	26.9	-	25.1	24.8
109.73	26.3	-	25.2	25.0
128.02	-	-	26.8	-
146.30	27.1	28.1	23.9	24.2
164.59	25.6	28.6	-	-
182.88	25.5	-	22.5	24.1
204.83	-	27.2	23.0	-
228.60	25.6	26.5	22.6	24.4
250.55	25.0	27.7	23.3	24.4
274.32	27.8	27.3	23.1	24.8
320.04	-	28.8	23.5	24.9
365.76	-	27.9	25.6	25.0
387.71	-	-	-	-
411.48	-	-	24.5	24.8
457.20	-	-	-	-
Overall	**26.4**	**27.4**	**23.0**	**24.7**

Figure 1 (APPENDIX A2). Location of transects sampled during Supplemental Survey cruises.

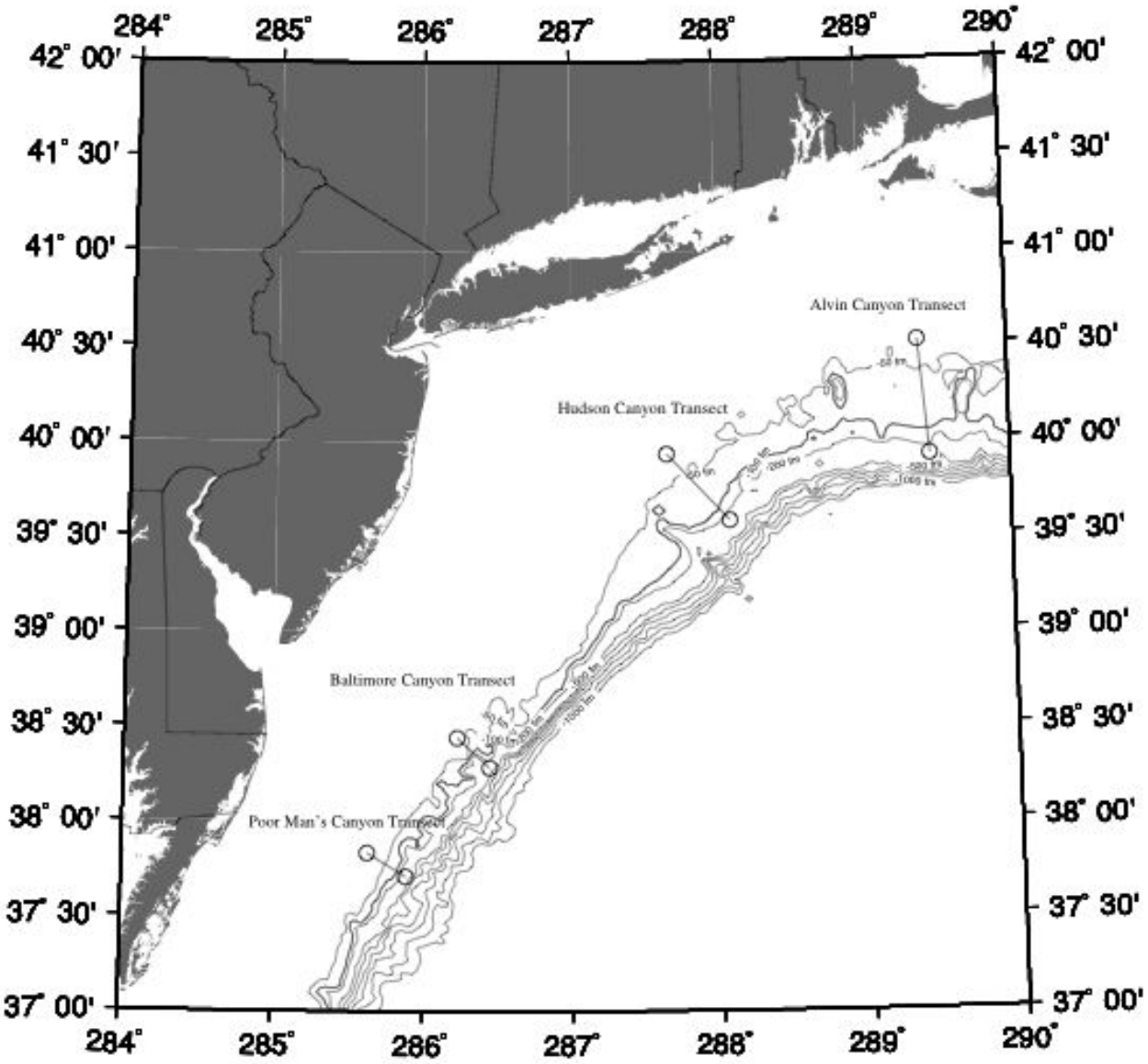

Figure 2 (APPENDIX A2). Swath distance for tows 1, 2, and 3, taken near a transect, showing the distance allotted to each tow had it actually been taken along the transect line.

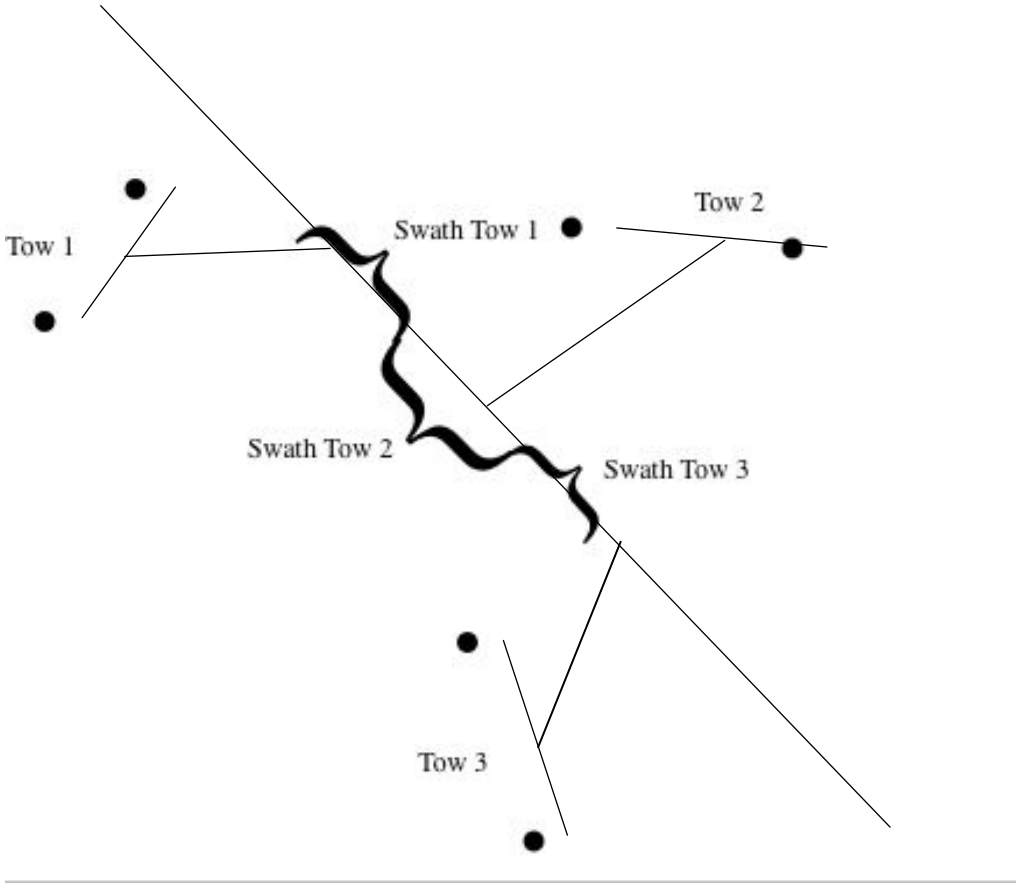

Figure 3 (APPENDIX A2). Projected biomass and abundance of whiting along each transect for each survey. In order to display all of the data on the same figure, there is an axis break in projected biomass. Logarithmic axis scaling was necessary in order to plot the projected abundances from all of the surveys on one figure.

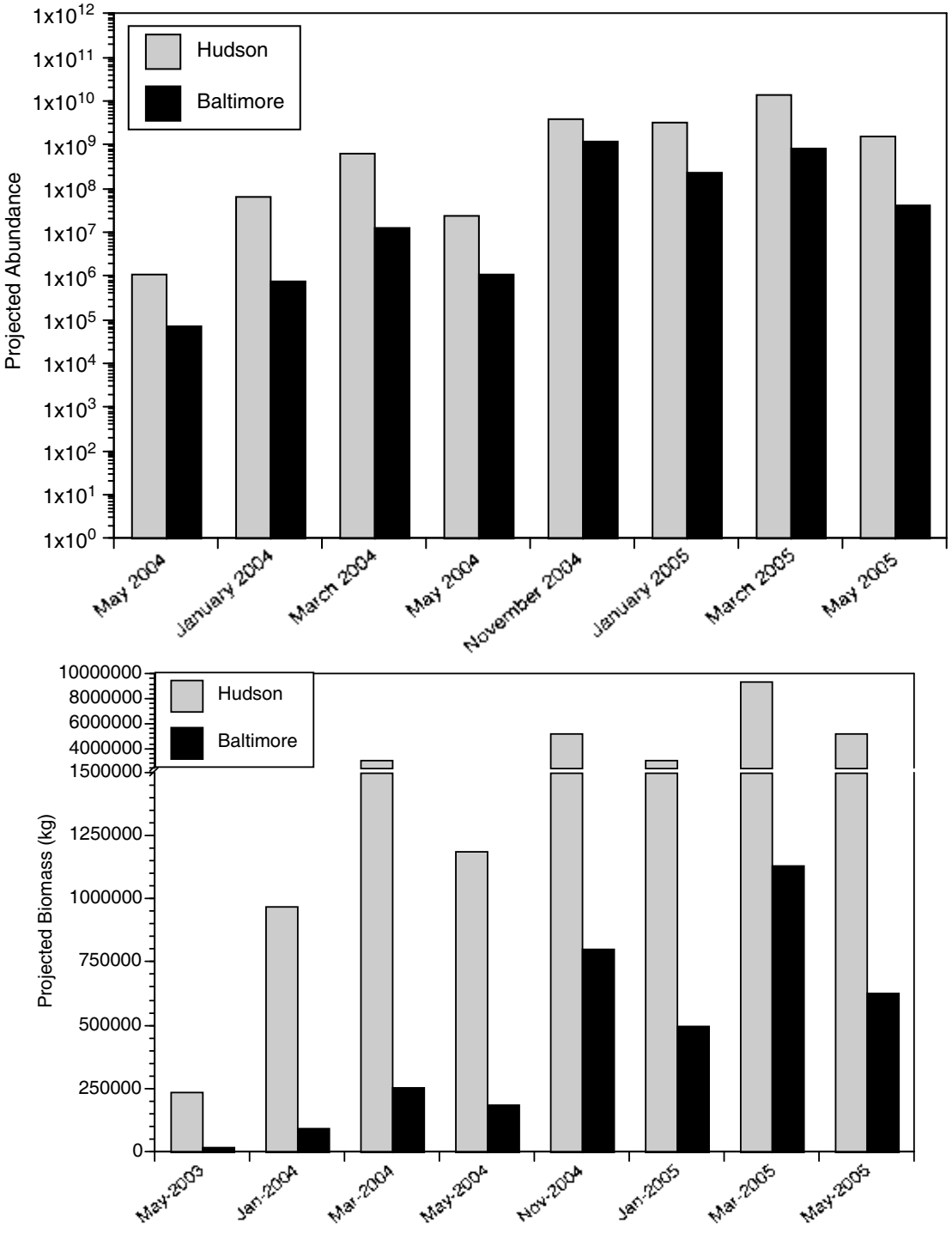

Figure 4 (APPENDIX A2). Comparison of changes in depth for the 20th, 50th, and 80th percentiles of cumulative catch during all surveys completed through May 2005. To calculate the percentiles, swath area catch (Table 2) was cumulated from the shallowest to the deepest station on each transect. The 20th percentile, for example, is the depth where the cumulative catch curve reached 20% of the total catch.

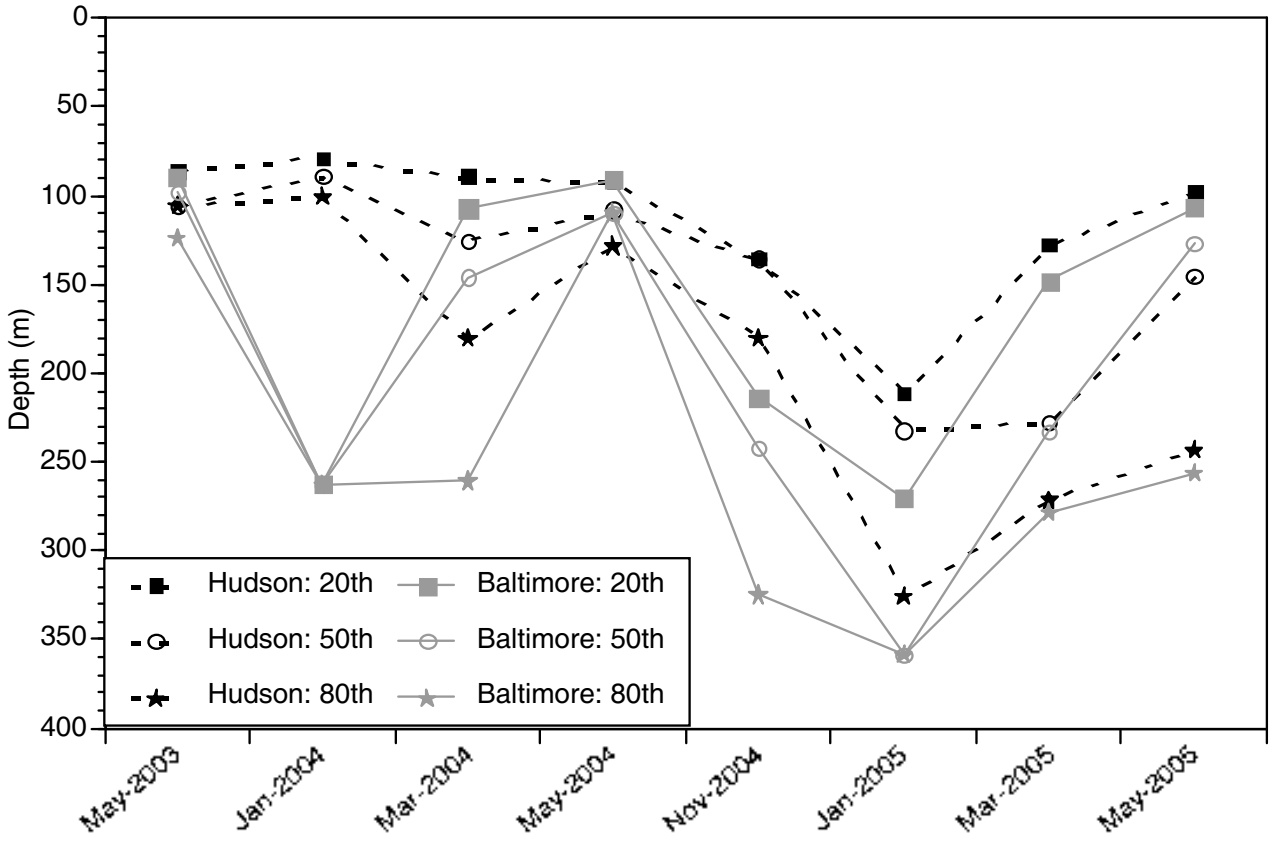

Figure 5 (APPENDIX A2). Projected number of whiting per size class across all tows for the March 2004 and 2005 surveys. Tow size frequencies were corrected to the number caught per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect. Logarithmic axis scaling was necessary in order to plot data from all surveys on one figure. Note: zeros were not plotted.

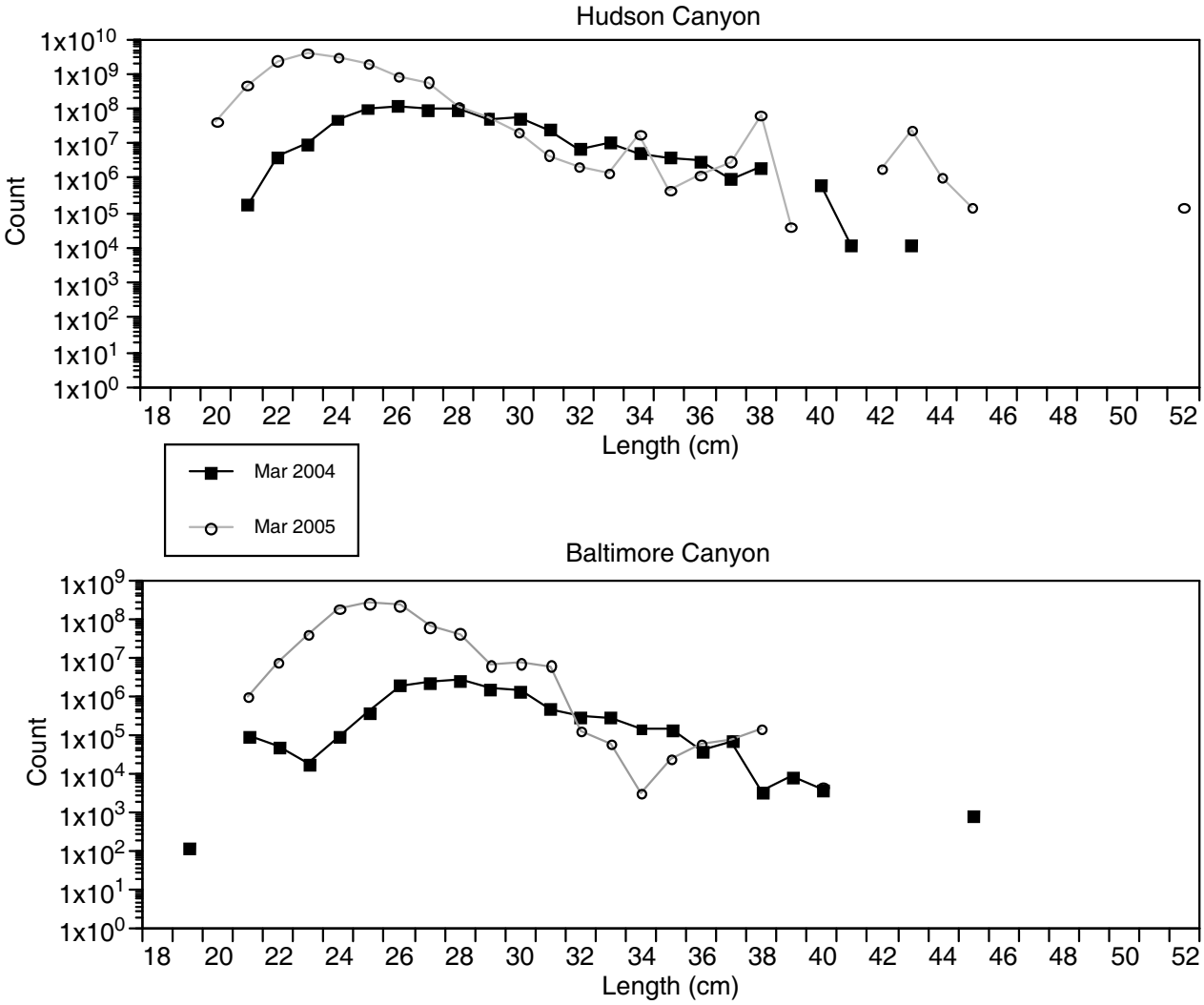

Figure 6 (APPENDIX A2). Relationship between length and weight for silver hake measured in March 2004 and 2005. f(x)=weight, x=length.

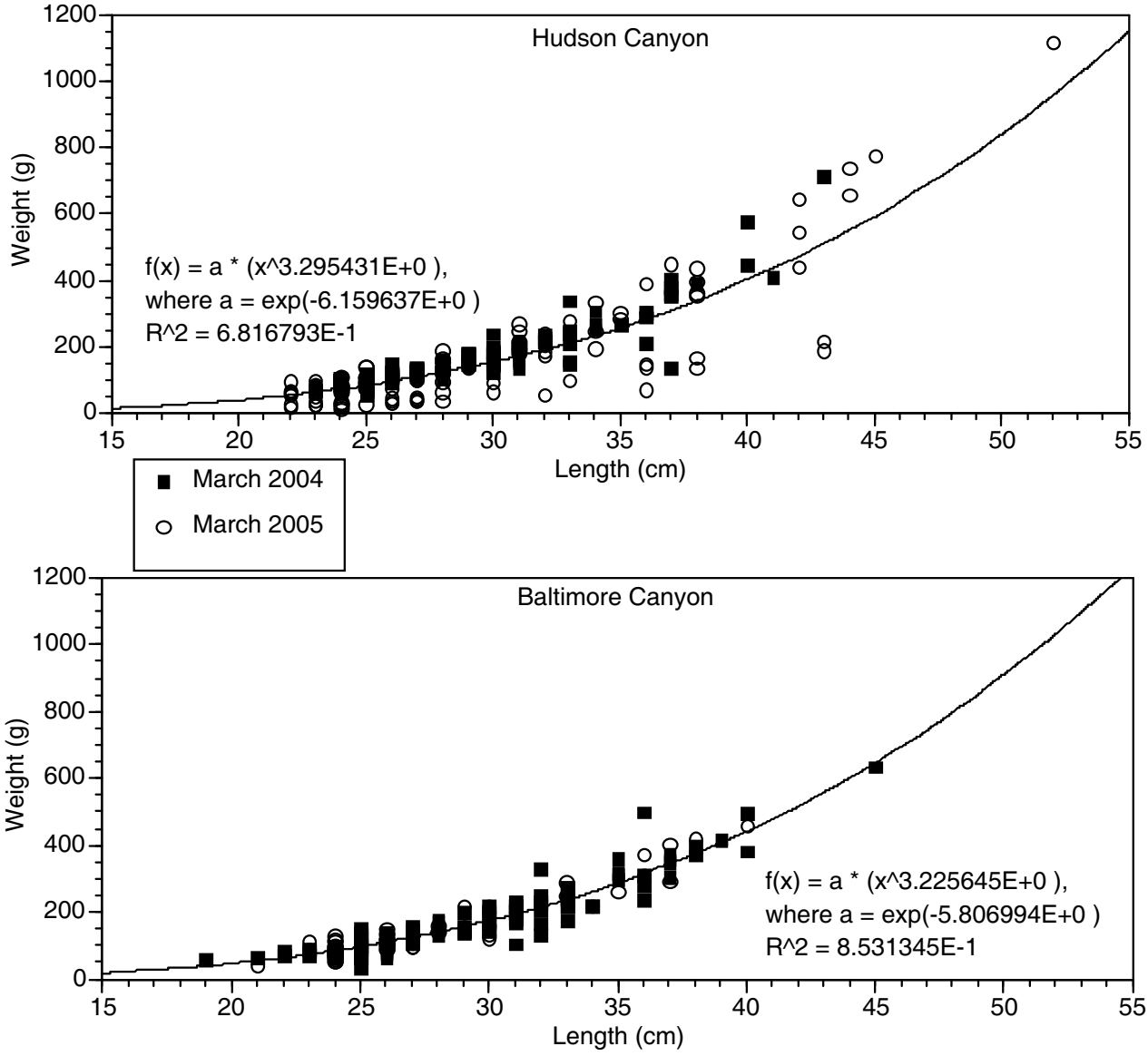

Figure 7 (APPENDIX A2). Cumulative size frequency for whiting from the March 2004 and 2005 surveys.