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UNITED STATES
DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
State, Federal & Constituent Programs Office

Final.
~~SEMI-ANNUAL~~ REPORT

Grantee: **NATIONAL FISHERIES INSTITUTE**

Project No: **02-RSA-002**

Grant No: **NA03NMF4540083**

Project Title: **DEVELOPMENT OF A SUPPLEMENTAL FINFISH SURVEY TARGETING MID-ATLANTIC MIGRATORY SPECIES**

Period Covered: **07/01/03 – 12/31/03**
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Prepared by:

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___Unallied Science Projects
_X_Unallied Mgmt. Projects

Haskin Shellfish Research Laboratory

Institute of Marine and Coastal Sciences – New Jersey Agricultural Experiment Station
Rutgers, The State University of New Jersey

TO: Joyce Lacerda
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SUBJECT: Supplemental Finfish Survey 2003 (NAO3NMF4540083)
Final abstract and expenditures

DATE: April 15, 2004

Supplemental Finfish Survey Targeting Mid-Atlantic Migratory Species Abstract

The supplemental finfish survey is a cooperative research program among the National Fisheries Institute-Scientific Monitoring Program (NFI-SMC), Rutgers University, Haskin Shellfish Research Laboratory (HSRL), and the National Marine Fisheries Service, Northeast Fisheries Science Center (NMFS-NEFSC). The program was funded by CMER and the MAFMC Research Set-Aside Program in 2003 and is funded by the MAFMC Research Set-Aside Program in 2004.

The main objectives of this project are: 1). to evaluate how fall downcoast and spring upcoast seasonal migration of fish in the Mid-Atlantic influences stock abundance estimates obtained from the winter and spring NMFS-NEFSC surveys and 2). to determine the extent to which migration offshore to depths beyond the limits of the winter and spring NEFSC-NMFS surveys influences abundance estimates. Many species move inshore and upcoast during the spring as the water warms and then move downcoast and offshore in the fall as the water cools. Some of these fish may seasonally move offshore beyond the range of present-day surveys. The NEFSC finfish surveys utilize a stratified random sampling design. Due to the scale of patchiness during migration, insufficient sampling density may occur in some strata in some years, and some groups of fish may avoid sampling. The cooperative supplemental finfish survey is designed to:

1. Monitor fish migration during the fall, winter, and spring.

2. Provide information that can be used to evaluate how year-to-year variation in migratory behavior can affect yearly changes in the NMFS survey abundance estimates.
3. Provide information as to the fraction of the stock offshore of the NMFS surveyed area.

This program has already met a series of important milestones. A planning workshop was conducted in Woods Hole at NMFS-NEFSC on January 16, 2003, attended by representatives from Academia, the NMFS, the MAFMC, and the fishing industry. Out of this workshop came the design for a full-scale supplemental finfish survey and a plan for a pilot program in 2003 to test and improve survey protocols. Field efforts occurred in March and May 2003. All March and May data have been successfully entered into the NMFS-NEFSC survey database. Protocols for data entry have been established and software developed to carry out this task seamlessly. Retrospective and planning meetings have bounded each cruise. Science personnel have consistently included representatives from HSRL and NMFS-NEFSC. The boat being used is the F/V Jason & Danielle out of Montauk, NY. A work plan for 2004, agreed upon by an informal committee of representatives from HSRL, NMFS-NEFSC, the MAFMC, NFI-SMC, and interested fishermen includes cruises in January, March, May, and November 2004.

The following two cruise reports have been released.

1. HSRL. 2003. Supplemental Finfish Survey Targeting Mid-Atlantic Migratory Species. March 2003 Cruise Report. Haskin Shellfish Research Laboratory, Rutgers University. 73 pp.
2. HSRL. 2003. Supplemental Finfish Survey Targeting Mid-Atlantic Migratory Species. May 2003 Cruise Report. Haskin Shellfish Research Laboratory, Rutgers University. 98 pp.

Project Expenditures

The NFI-SMC auction raised $140,098.90 through compensation fishing for the 2003 supplemental finfish survey research set-aside project. Expenditures were as follows:

1. Vessel costs: $32,500
2. Non-vessel costs: $54,540.38.

Total project expenditures through 2003 were $87,040.38. By agreement with NMFS, the remaining $53,058.52 was held for the January 2004 mission, with the intent of trying to complete four full cruise transects in 2004. The bills are not in for the January 2004 cruise, as the 2004 mission is part of this year's program. The two cruises in 2003 were a successful pilot program, which has been expanded in 2004.

Supplemental Finfish Survey Targeting Mid-Atlantic Migratory Species

May 2003 Cruise Report

Funded by the
MAFMC Research Set-Aside Program

National Fisheries Institute – Scientific Monitoring Committee
and
Haskin Shellfish Research Laboratory – Rutgers, The State University of New Jersey

May 2003 Supplemental Survey Cruise Report

The goals of the supplemental survey program are 1) to track the seasonal movements of selected fish species, particularly the fall offshore and downcoast migration coincident with declining temperatures and the spring upcoast and onshore migration that occurs as the water warms, and 2) to extend the supplemental survey beyond the domain of present-day NMFS-NEFSC surveys. As a consequence, the survey design includes spatial and temporal components, and sampling intensity is increased between 150 and 250 fm.

Organization of stations and target species

Stations are organized into cross-shelf transects oriented perpendicular to the average trend of the depth contours. The May survey sampled two fixed transects: oriented just east of Hudson Canyon (72°W) and just north of Baltimore Canyon (38°20′ N) (Figures 1 & 2). Stations were distributed by depth along each transect. Fixed stations were located at 40, 50, 60, 80, 100, 125, 150, 200, 225, and 250 fm along the Hudson Canyon transect. Fixed stations on the Baltimore Canyon transect were located at 40, 50, 60, 80, 100, 125, 150, 200, and 225 fm. The 250 fm station was not occupied on the Baltimore Canyon transect due to the steep depth gradient in the area.

An additional five adaptive stations at Hudson Canyon and four adaptive stations at Baltimore Canyon were sited in an unbiased way while at sea based on the catches of target species at the fixed stations. Target species were summer flounder, scup, black sea bass, monkfish, spiny dogfish, silver+offshore hake, and *Loligo* squid. To create adaptive stations, fixed stations providing the highest overall ranking based on the catch of target species were identified. Adaptive stations were placed one-half depth increment between fixed station pairs that had the highest combined station ranks based on the sum of the target species ranks at each station until all four adaptive stations were allocated. An example in the form of an Excel spreadsheet is presented as Figure 3.

During the May survey, tows at the fixed stations, and any repeated adaptive stations, were designed to occur at the same positions as tows at the same depths from the March survey. In most cases, the tows were made in almost exactly the same locations. Two tows (150 fm and 225 fm) taken during the March survey were hauled early due to lobster pots and complications with the gear on the bottom. These tows were lengthened during the May survey. One other tow from the March survey (60 fm tow at Baltimore Canyon) was taken far enough off the main transect to require repositioning in May.

Hudson Canyon

Fixed Stations, May Positions

	Starting Position		Ending Position		Depth	
Station #	Latitude	Longitude	Latitude	Longitude	Average	(Target)
1	39° 55.801′	72° 20.810′	39° 53.877′	72° 22.154′	40 fm	(40 fm)
2	39° 48.164′	72° 11.400′	39° 48.321′	72° 08.468′	50 fm	(50 fm)
3	39° 45.790′	72° 07.500′	39° 44.680′	72° 09.850′	60 fm	(60 fm)
4	39° 42 420′	72° 03.140′	39° 40.586′	72° 04.843′	80 fm	(80 fm)
5	39° 39.650′	72° 01.390′	39° 41.391′	71° 59.771′	100 fm	(100 fm)
6	39° 40.350′	71° 59.040′	39° 38.446′	72° 00.183′	125 fm	(125 fm)
7	39° 39.680′	71° 57.970′	39° 41.647′	71° 57.044′	154 fm	(150 fm)
8	39° 38.530′	71° 56.580′	39° 36.510′	71° 57.580′	200 fm	(200 fm)
9	39° 36.540′	71° 57.330′	39° 38.440′	71° 56.170′	221 fm	(225 fm)
10	39° 38.280′	71° 55.740′	39° 36.120′	71° 56.330′	244 fm	(250 fm)

Adaptive Stations, May Positions

Station #	Latitude	Longitude	Latitude	Longitude	Average	(Target)
11	39° 41 040′	72° 07.270′	39° 42.730′	72° 05.440′	70 fm	(70 fm)
12	39° 46.600′	72° 07.080′	39° 45.880′	72° 09.960′	55 fm	(55 fm)
13	39° 53.610′	72° 16.410′	39° 55.800′	72° 16.800′	45 fm	(45 fm)
27	39° 36.622′	71° 59.825′	39° 38.541′	71° 57.509′	178 fm	(175 fm)
28	39° 39.470′	71° 58.830′	39° 37.484′	72° 00.181′	137 fm	(137.5 fm)

Baltimore Canyon, May Positions

Fixed Stations

	Starting Position		Ending Position		Depth	
Station #	Latitude	Longitude	Latitude	Longitude	Average	(Target)
14	38° 15.757′	73° 38.252′	38° 17.727′	73° 36.745′	123 fm	(125 fm)
15	38° 17.693′	73° 36.446′	38° 15.649′	73° 37.233′	151 fm	(150 fm)
16	38° 15.906′	73° 38.653′	38° 17.717′	73° 37.210′	100 fm	(100 fm)
17	38° 17.770′	73° 37.900′	38° 15.822′	73° 39.433′	80 fm	(80 fm)
18	38° 21.568′	73° 42.080′	38° 23.143′	73° 40.164′	60 fm	(60 fm)
19	38° 23.366′	73° 42.965′	38° 21.947′	73° 45.115′	50 fm	(50 fm)
20	38° 23.290′	73° 47.480′	38° 21.796′	73° 49.552′	40 fm	(40 fm)
21	38° 17.290′	73° 36.254′	38° 15.130′	73° 36.400′	199 fm	(200 fm)
22	38° 15.679′	73° 36.588′	38° 17.689′	73° 36.021′	217 fm	(225 fm)

Adaptive Stations, May Positions

Station #	Latitude	Longitude	Latitude	Longitude	Average	(Target)
23	38° 17.537′	73° 36.585′	38° 15.530′	73° 37.800′	140 fm	(137.5 fm)
24	38° 15.880′	73° 38.520′	38° 17.790′	73° 36.910′	111 fm	112.5 fm)
25	38° 20.159′	73° 38.921′	38° 21.441′	73° 36.639′	69 fm	(70 fm)
26	38° 22.191′	73° 43.335′	38° 23.588′	73° 41.171′	55 fm	(55 fm)

Station Sampling Protocol

Tows were made at the fixed stations according to the locations of tows from the March survey. In most cases, the captain set and hauled at a position close to the set and haul positions from the March survey. If the adaptive stations fell at depths that were sampled during the March survey, the set and haul positions from the March survey were used. If new adaptive stations were chosen, the captain was allowed time to search an area of about 1 nautical mile in diameter at that depth to choose where to make the tow. These new positions will be used in the future should adaptive stations be chosen at those depths.

Tows were a fixed distance of 2 nautical miles. Tow speed was maintained near 3 knots. Tows were oriented along-slope to the extent possible, unless local conditions dictated a different approach. DGPS position was logged to 0.01′ latitude and longitude every 1 minute during the tow. Depth, door spread, GMT, and GPS position were logged manually every 5 minutes by the captain. Depth and bottom water temperature were logged remotely at 1-minute intervals using a Vemco sensor attached to the top of the codend.

Gear

The target species included a combination of groundfish and other species. To permit efficient capture of groundfish while also maintaining a reasonable degree of catchability for other species such as scup, a 4-seam box net with a standard 6-cm codend (liner) was used. The fishing circle of the net is 506 meshes of 6″ mesh. The extension of the net is 3″ mesh knot to knot, 100 meshes long, and 225 meshes around. The codend is made of 6.5″ mesh knot to knot, 100 meshes long, 70 meshes around, and is lined with a 6-cm mesh liner. The chaffing gear is a mat made of 6″ mesh covering 2/3 of the bottom of the codend. The doors are 104″ Thyboron with a spoiler. Each door weighs 1640 pounds. The footrope is constructed from 114′ 6.5″ × 1/2″ stainless steel wire wrapped with #12 polyester with 2 wire extensions of 6′ 5.16″ eye to eye joined with two 3/4″ bow shackles for an overall length of 127′ 11″. The headrope is 117′ 11.52″ overall length, including the extensions. There are 92 8″ hi-impact floats hung in groups of 6 on 5/8″ poly plus, grouped closely together in the center with a set of 6 on each wing. The traveler is made of 1/2″ stainless steel wire banded with 1/2″ stainless steel bands to the footrope. The overall length is 119′, with the stainless steel bands spaced at 1′ 11″ intervals. The sweep is made up of 5/8″ stainless steel wire with 84 1.4 pound leads in the center section and 3 link 1/2″ trix drop chains at 1′ 11″ intervals throughout. The sweep is in three sections joined with 1/2″ hanging locks and 2′ 6″ of 1/2″ trix chains on each wing end. Each wing is 46′ 6.84″ eye to eye and the bosom is 29′ 2.28″ eye to eye. The sweep is covered with 3″ rubber cookies.

Sample Processing Protocol

Sample processing protocol followed standard NMFS survey methods. Each tow was sorted to species and catch weights were obtained for each species. These species included: summer flounder, scup, black sea bass, monkfish, spiny dogfish, skates, yellowtail flounder, winter flounder American lobster, silver/offshore hake, and *Loligo* squid. Priority species were then measured. The goal for each priority species was 100 length measurements for each tow. If fewer than 100 individuals were caught, all of the individuals were measured. Each priority species was then divided into size classes and the first 3 individuals measured in each size class were weighed. Neither yellowtail flounder nor winter flounder were caught in any of the tows. Personnel availability limited the amount of biological sampling done on the May survey, but scale and otolith samples were taken from large summer flounder (> 60 cm).

Species	# Length Measurements	# Weight Measurements	# Samples Taken/Type
Offshore Hake	1572	176	0
Loligo squid	1021	26	0
Monkfish	782	301	0
Black sea bass	584	109	0
Silver Hake	662	134	0
Illex Squid	431	7	0
Spiny dogfish	343	74	0
Scup	293	64	0
American lobster	110	1	0
Summer flounder	46	44	5/Otoliths 5/Scales
Thorny skate	42	25	0
Smooth skate	25	26	0
Rosette Skate	16	7	0
Barndoor skate	8	8	0

Results

A total of 28 tows were made during the May 2003 survey. Fifteen tows were taken along the Hudson Canyon transect and 13 along the Baltimore Canyon transect. Due to the rapidly changing depth contours in Baltimore Canyon, it was difficult to maintain a constant depth in the deep-water stations. Nevertheless, the average tow depths were relatively close to the target depths for all tows (Table 1). Almost all of the tows lasted about 40-50 minutes and covered approximately 3.6-4.7 km.

Table 1 presents the basic tow information for each tow. Average depth was calculated as the average of all of the depths recorded by the Vemco minilogger

during the tow. Depth range is the difference between the deepest and shallowest depth recorded during each tow. Scope was calculated by dividing the amount of tow wire out (m) by the average depth (m) of each tow, and normally fell between 2.0 and 3.5 m. Tow time (h) is the duration of each tow, speed (km/h) is distance traveled divided by the duration of each tow, and distance (km) was calculated using the beginning and ending positions of each tow as defined after comparing the Vemco minilogger depth record to annotations on the DGPS data. Tow distance was approximately 3.6 to 4.6 km in most cases and tow speed range varied by no more than 10% from 5 km/hr. Swept area (km^2) was calculated by multiplying the average door spread (m) by the distance traveled for each tow (km), and normally fell between 0.24 and 0.31 km^2.

Swath area measures the relative importance of each sampled depth according to its contribution to total distance along the transect set perpendicular to the depth contour. Figure 4 shows an example of how the distance along the transect 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 along the main axis of the transect 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.

Table 2 lists the total catch, in kilograms, for each species caught on the survey. A line indicates the species whose total catch was greater than 1% of the total catch of all species. Table 3 lists the number of tows and the percentage of the total tows in which each species was caught.

Figures 5a-25a depict, by transect, the swept area catch (kg/km^2) for most species whose total catch was greater than 1% of the total catch of all species, and for selected other commercially-important species: summer flounder, American lobster, *Loligo* squid, black sea bass, scup, and tilefish. Figures 5b-25b depict, by transect, the projected catch of each species for a distance along the transect represented by each tow swath. Figures 26a-36a represent the cumulative size-frequency distributions obtained by first normalizing each tow's data to swept area and then summing across all tows in each transect. Figures 26b-36b show the cumulative size-frequency distributions, corrected first to swept area as before, but then normalized to swath distance along the transect, and finally summed across all tows in each transect. Figures 37-44 are the cumulative size-frequencies, by tow, for each measured species with greater than 20 individuals measured per tow. Figures 45-51 show the relationship between length and weight per species by tow for each transect.

Figures 52a and 52b show the relationship between selected measures of sampling performance and temperatue between the March and May surveys.

Overall, little variation occurred between the two surveys. Tow depth varied little. Depth range was more variable, but generally it increased with increasing target depth (Figure 53). Scope varied consistently with depth as expected (Figure 53). The two outliers in the swept area and tow distance plots are the two short tows (150 fm and 225 fm) from the March survey that were lengthened during the May survey. Otherwise, swept area and tow distance varied little. The two surveys resulted in a similar distribution between tow times and tow speeds. The ranges of tow times is about the same in March and May. Bottom temperature varied little between the two surveys.

Figures 54a and 54b compare the 20th, 50th, and 80th percentiles of depth distribution of species based on kg caught at each depth for each species in March and May. To calculate the percentiles, swath area catch (Figures 5b-25b) 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. As examples, the figure for scup indicates that the population moved to shallower depths from March to May on both the Hudson and Baltimore Canyon transects. The same is true of northern sea robin and American lobster. In May, spiny dogfish moved to shallower areas in Hudson Canyon and to deeper areas in Baltimore Canyon. *Illex* squid shows a broad distribution across the shelf in March and a narrower depth range in May, mainly due to consolidation of individuals from the deeper areas into the shallower depths.

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Table 1. Results of data recorded for each tow. Transect 1 = Hudson Canyon Transect; Transect 2= Baltimore Canyon Transect. Target depth represents the depths at which the fixed positions were chosen before the cruise. Tow depth represents the actual depth. at which each tow was made, calculated as the average of the depths recorded every minute during the tow

Transect	Tow	Date	Tow Begin Time (Military)	Target Depth m	Tow Depth m	Depth Range m	Scope m	Swept Area km2	Swath Area km2	Bottom Temperature F	Tow Time h	Tow Speed km/h	Tow Distance km
1	1	5/26/03	6:07	73.15	70.02	9.80	3.92	0.26	151.59	41.11	0.75	5.74	4.31
1	2	5/26/03	08:41	91.44	85.90	9.70	3.19	0.25	568.13	41.68	0.77	5.55	4.26
1	3	5/26/03	10:39	109.73	105.58	3.30	3.03	0.28	263.42	47.48	0.77	5.55	4.26
1	4	5/26/03	13:29	146.30	141.34	6.50	2.91	0.28	238.81	50.07	0.78	5.55	4.35
1	5	5/26/03	15:42	182.88	177.37	13.00	3.09	0.27	227.26	51.13	0.80	5.27	4.21
1	6	5/26/03	17:22	228.60	224.45	19.50	2.65	0.26	122.79	51.52	0.77	5.43	4.16
1	7	5/26/03	19:03	274.32	276.90	13.10	2.31	0.24	83.05	48.70	0.70	5.18	3.62
1	8	5/26/03	20:58	365.76	360.97	22.80	2.28	0.27	42.14	45.38	0.85	5.00	4.25
1	9	5/27/03	01:08	411.48	388.81	35.80	2.23	0.24	41.32	43.49	0.82	4.85	3.96
1	10	5/27/03	03:54	457.20	418.33	52.10	2.08	0.22	38.91	43.11	0.77	4.92	3.77
1	11	5/27/03	06:43	128.02	123.67	6.50	3.33	0.28	322.71	49.54	0.78	5.30	4.15
1	12	5/27/03	09:05	100.58	99.12	9.70	2.77	0.31	174.95	47.51	0.85	5.51	4.68
1	13	5/27/03	11:38	82.30	77.96	3.30	3.52	0.28	610.54	40.93	0.88	5.23	4.62
2	14	5/28/03	05:22	228.60	223.81	48.90	3.06	0.27	29.55	52.28	0.85	5.24	4.45
2	15	5/28/03	09:27	274.32	278.37	101.00	2.46	0.27	46.00	47.94	0.82	5.38	4.39
2	16	5/28/03	11:42	182.88	180.59	16.30	3.04	0.25	31.30	52.47	0.78	5.11	4.00
2	17	5/28/03	13:52	146.30	144.30	13.00	3.17	0.26	129.46	52.20	0.73	5.49	4.02
2	18	5/28/03	15:46	109.73	106.71	3.30	3.00	0.25	233.44	47.58	0.73	5.60	4.10
2	19	5/28/03	17:04	91.44	89.98	3.30	3.05	0.26	225.31	43.01	0.73	5.67	4.16
2	20	5/28/03	18:48	73.15	70.31	3.30	3.90	0.28	167.04	43.25	0.80	5.54	4.43
2	21	5/28/03	21:29	365.76	356.74	114.00	2.31	0.26	66.99	44.98	0.82	5.03	4.11
2	22	5/28/03	23:10	411.48	371.23	100.90	2.34	0.25	28.26	44.81	0.82	4.80	3.92
2	23	5/29/03	05:11	252.37	258.49	81.40	2.65	0.28	29.98	50.21	0.83	5.27	4.39
2	24	5/29/03	06:40	206.65	197.17	19.60	3.01	0.28	15.96	51.57	0.87	5.17	4.48
2	25	5/29/03	09:10	128.02	123.60	3.30	3.33	0.26	278.86	51.69	0.78	5.30	4.15
2	26	5/29/03	11:08	100.58	97.70	0.00	2.81	0.26	122.47	45.12	0.73	5.54	4.06
1	27	5/30/03	03:21	320.04	320.87	35.90	2.42	0.25	156.34	47.33	0.77	5.06	3.88
1	28	5/30/03	05:13	252.37	245.82	9.80	2.79	0.27	9.08	49.93	0.80	5.30	4.24

Table 2. Total catch in kg for each species caught during the May 2003 survey. Species above the line represent those species whose total catch was greater than 1% of the total catch of all species.

Species	Total Catch (kg)
Atlantic Mackerel	5089.81
Offshore Hake	3659.18
Anemone, unk.	2292.79
Monkfish	1638.03
Smooth Dogfish	1374.92
Little Skate	1094.58
Spotted Hake	1081.51
Fourspot Flounder	1065.07
Butterfish	999.23
Witch Flounder	678.60
Illex Squid	661.29
Atlantic Herring	649.94
Starfish, Unk.	428.94
Spiny Dogfish	367.78
Jonah Crab	341.43
Deepsea Red Crab	309.06
Silver Hake	304.53
Sea Potato	234.30
Chain Dogfish	220.15
Blackbelly Rosefish	165.37
Red Hake	163.18
Rosette Skate	153.37
Black Sea Bass	133.47
American Shad	98.96
Sea Scallop	97.13
Scup	96.57
Loligo Squid	76.88
American Lobster	61.74
Summer Flounder	61.17
Tilefish	52.31
White Hake	50.77
Barndoor Skate	49.37
Longfin hake	48.97
Atlantic Torpedo Ray	44.92
Striped Sea Robin	42.19
Rock Crab	33.15
Smooth Skate	30.09
Shell, Unk.	28.62
Thorny Skate	28.20
Conger Eel	20.22
Blueline Tilefish	20.21
Sand Worms, Unk.	17.94
Armored Sea Robin	15.95
John Dory	15.84
Shrimp, Unk.	11.73
Roshinia grassa	10.52
Longspine Snipefish	9.99
Gladiator Box Crab	7.87
Deepbody Boarfish	7.22
Grenadier, Unk.	7.08
Streamer Bass	6.29
Northern Sea Robin	5.42

Species	Total Catch (kg)
Galatheid, Unk.	5.29
Batfish, Unk.	4.79
Spiny Sea Robin	4.40
Redfish, Unk.	4.38
Alewife	3.58
Gulfstream Flounder	3.28
Clearnose Skate	3.25
Ocean Pout	3.09
Shortnose Greeneye	2.86
Palefin Dragonet	2.82
Pholitoteuthus adam	2.64
Marlinspike Granadier	2.17
Longnose Greeneye	1.90
Wrymouth	1.83
Gadella imberbis	1.81
Bathyal Swimming Crab	1.75
Ventrifossa occidentali	1.72
Goby Flathead	1.43
Fawn Cusk eel	1.33
Slender Snip Eel	0.82
Striated Argentine	0.56
Hermit Crab, Unk.	0.52
Sigmops elongatum	0.51
Black Gemfish	0.51
Roughy, Unk.	0.40
Bluefish	0.40
Portunid, Unk.	0.40
Octopus, Unk.	0.34
Singlespot Frogfish	0.34
Keelcheek Bass	0.34
Boa Dragonfish	0.33
Beardfish	0.30
Redeye Gaper	0.28
Epigonus pandionus	0.27
Atlantic Argentine	0.23
Spotted Tinselfish	0.22
Red Dory	0.14
Spoonarm Octopus	0.14
Sloan's Viperfish	0.14
Silver Hatchetfish	0.09
Crab, unk.	0.09
Greenland Halibut	0.09
Fourbeard Rockling	0.07
Cunner	0.05
Decorator Crab	0.05
Ocean Quahog	0.05
Squalidae, Unk.	0.05
Silver Roughy	0.05
Bobtail Squid	0.05
Barracudina	0.05
Histiotheus sp.	0.05
Slipper Lobster	0.05
Polymetme sp.	0.04

Table 3. Number and percentage of tows in which each species was caught.

Species	# Times Caught	Percentage
Jonah Crab	28	100
Witch Flounder	28	100
Monkfish	28	100
Illex Squid	28	100
Spotted Hake	24	86
Chain Dogfish	23	82
Fourspot Flounder	21	75
American Lobster	21	75
Red Hake	20	71
Butterfish	19	68
Gulfstream Flounder	19	68
Rock Crab	18	64
Spiny Dogfish	18	64
Loligo Squid	18	64
Offshore Hake	17	61
Silver Hake	16	57
Blackbelly Rosefish	16	57
Rosette Skate	15	54
Smooth Dogfish	15	54
Scup	14	50
Galatheid, Unk.	14	50
Starfish. Unk.	13	46
Fawn Cusk Eel	13	46
Black Sea Bass	12	43
Atlantic Mackerel	12	43
Summer Flounder	12	43
Bathyal Swimming Crab	12	43
Roshinia Grassa	12	43
John Dory	11	39
Armored Sea Robin	11	39
Shrimp, Unk.	11	39
Little Skate	10	36
American Shad	10	36
Shortnose Greeneye	10	36
Deepsea Red Crab	10	36
Sea Potato	10	36
Slender Snipe Eel	10	36
White Hake	9	32
Alewife	8	29
Striped Sea Robin	8	29
Tilefish	8	29
Gladiator Box Crab	8	29
Anemone, Unk.	8	29
Batfish, Unk.	8	29
Atlantic Herring	7	25
Conger Eel	7	25
Grenadier, Unk.	7	25
Striated Argentine	6	21
Beardfish	6	21
Hermit Crab, Unk.	6	21
Longfin Hake	6	21
Smooth Skate	6	21
Thorny Skate	6	21
Sea Scallop	5	18
Barndoor Skate	5	18
Northern Sea Robin	5	18
Atlantic Torpedo Ray	5	18
Gadella imberbis	5	18
Blueline Tilefish	5	18
Shell, Unk.	4	14
Streamer Bass	4	14
Epigonus pandionus	4	14
Boa Dragonfish	4	14
Sand Worms, Unk.	4	14
Spotted Tinselfish	4	14
Marlinspike Granadier	4	14
Longnose Greeneye	3	11
Red Dory	3	11
Goby Flathead	3	11
Roughy, Unk.	3	11
Silver Hatchetfish	3	11
Black Gemfish	3	11
Sigmops elongatum	3	11
Deepbody Boarfish	3	11
Ventrifossa occidentali	3	11
Spoonarm Octopus	3	11
Redfish, Unk.	2	7
Palefin Dragonet	2	7
Fourbeard Rockling	2	7
Pholitoteuthus adami	2	7
Keelcheek Bass	2	7
Crab, Unk.	2	7
Sloan'sViperfish	2	7
Longspine Snipefish	2	7
Portunid, Unk.	2	7
Clearnose Skate	1	4
Cunner	1	4
Decorator Crab	1	4
Octopus, Unk.	1	4
Wrymouth	1	4
Atlantic Argentine	1	4
Greenland Halibut	1	4
Redeye Gaper	1	4
singlespot Frogfish	1	4
Ocean Pout	1	4
Bluefish	1	4
Ocean Quahog	1	4
Squalidae, Unk.	1	4
Silver Roughy	1	4
Polymetme sp.	1	4
Bobtail Squid	1	4
Barracudina	1	4
Histiotheus sp.	1	4
Spiny Sea Robin	1	4
Slipper Lobster	1	4

Figure 1. Location of tows made along the Hudson Canyon Transect in May 2003. Fixed tows are marked with triangles as the tow begin point and circles as the tow end point. Adaptive tows are marked with stars as the beginning and ending points.

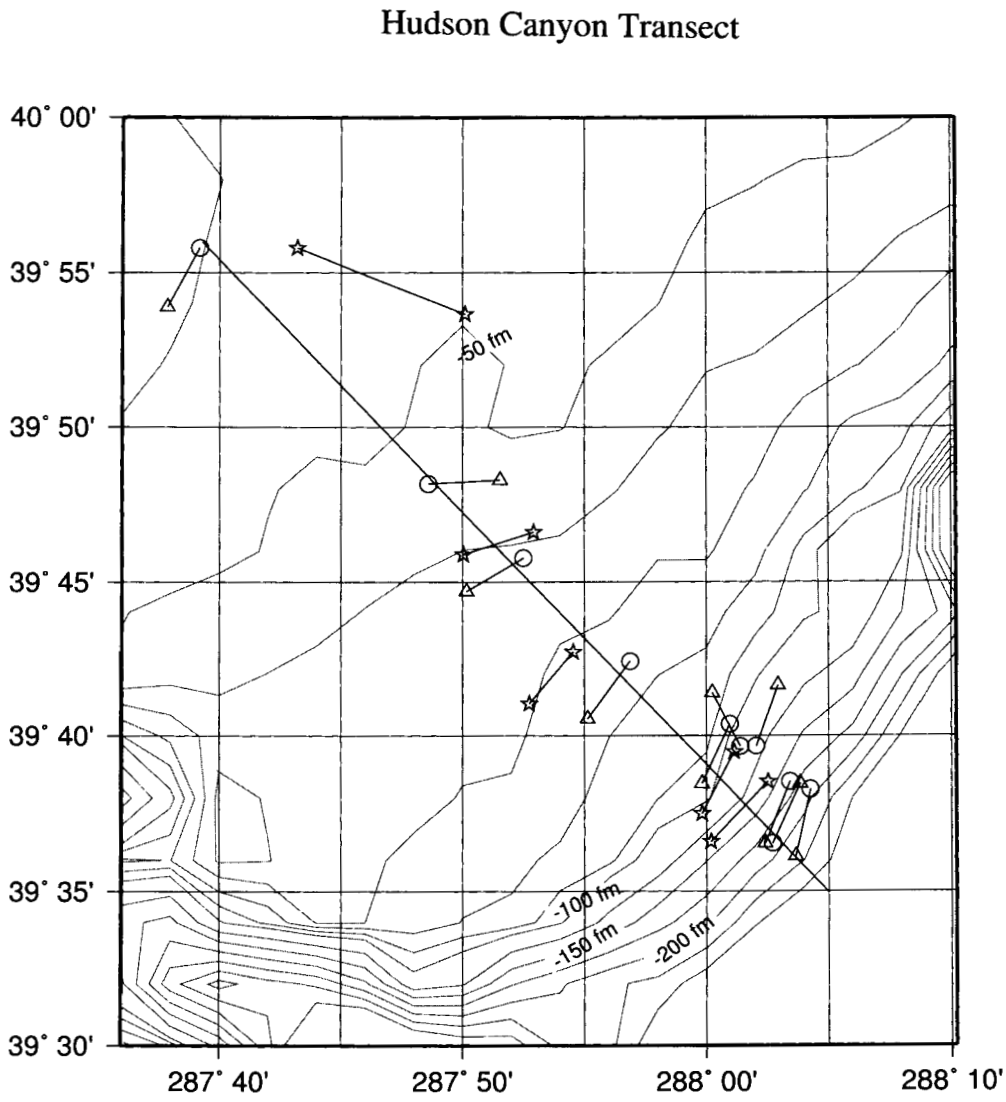


Figure 2. Location of tows made along the Baltimore Canyon Transect in May 2003. Fixed tows are marked with triangles as the tow begin point and circles as the tow end point. Adaptive tows are marked with stars as the beginning and ending points.

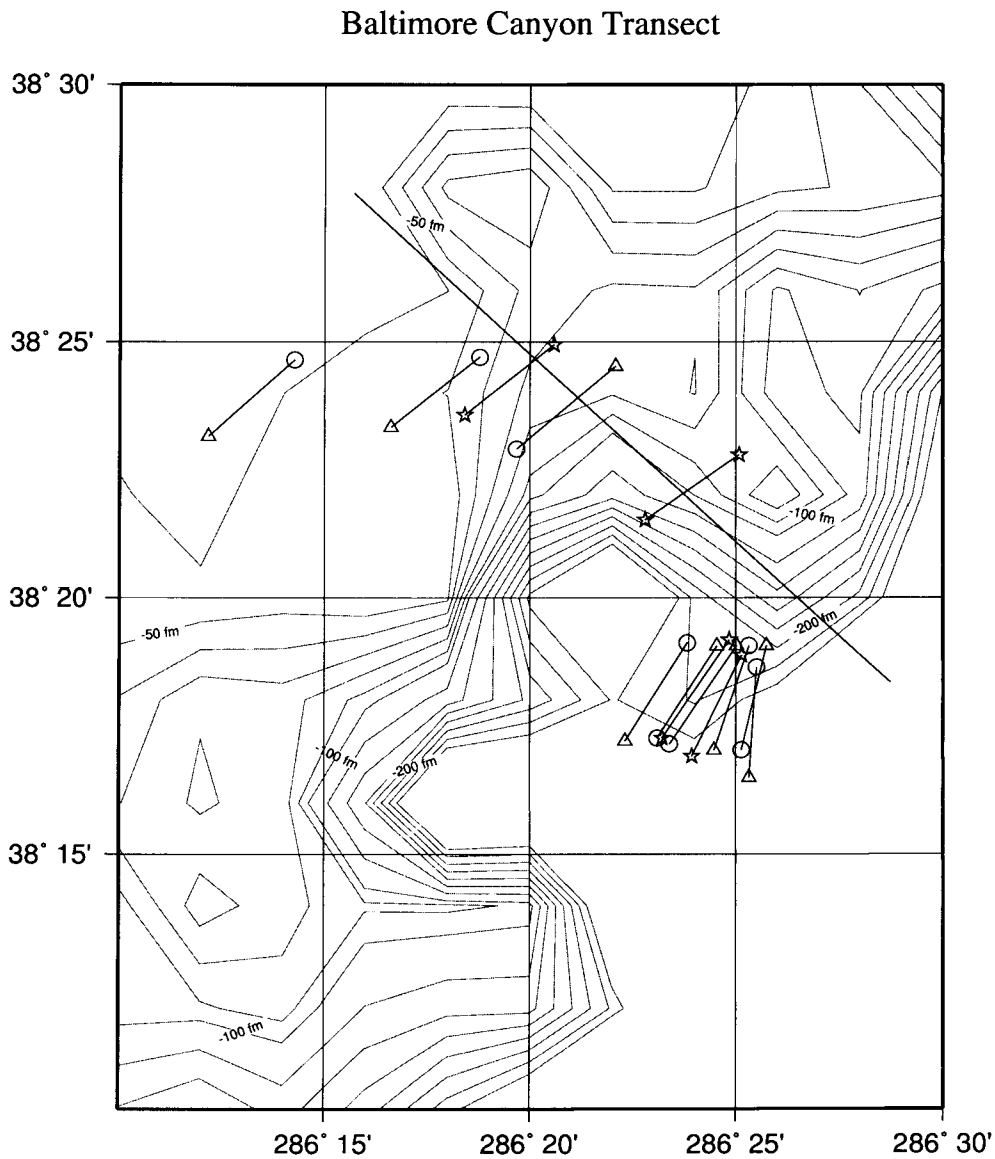
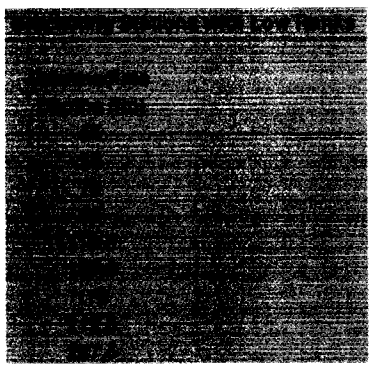


Figure 3. Example of calculations used to select adaptive tows for the survey. The stations are ranked according to catches of target species. The ranks are summed (Sum column in lower left table). Potential intermediate stations are established between each of the fixed stations (upper right table). The five to be sampled are indentified by the five lowest scores (averages of total catces at adjacent fixed stations) in the Sum column (*** in lower right table).

Rank of Catch by Species

Fixed Station	Summer Flounder	Scup	Sea Bass	Loligo	Silver/ Offshore Hake	Monkfish	Spiny Dogfish	Sum
40	6	1	4	4	8	10	9	42
50	1	2	1	2	9	8	3	26
60	4	2	2	1	10	9	4	32
80	5	2	6	3	7	6	8	37
100	2	3	3	5	6	7	5	31
125	3	3	7	6	4	4	7	34
150	7	3	7	6	1	5	2	31
200	7	3	5	6	3	1	1	26
225	7	3	7	6	2	2	6	33
250	7	3	7	6	5	3	10	41



Integrating Ranks Between Stations

Intermediate Depths (fm)	Sum of Ranks	
45	34	
55	29	***
70	34.5	
90	34	
112.5	32.5	***
137.5	32.5	***
175	28.5	***
212.5	29.5	***
237.5	37	

Figure 4. Swath distance for tows 1, 2, and 3, taken near a transect, showing the distance allotted to each tow had it actually been taken alng the transect.

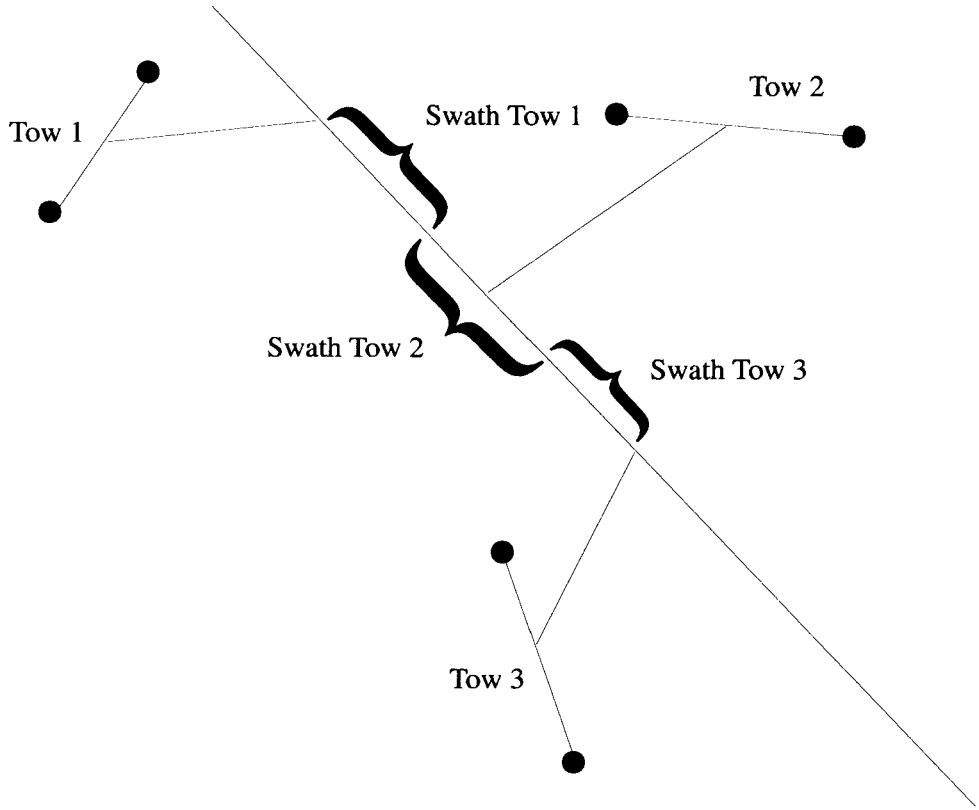


Figure 5a. Catches of American lobster in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

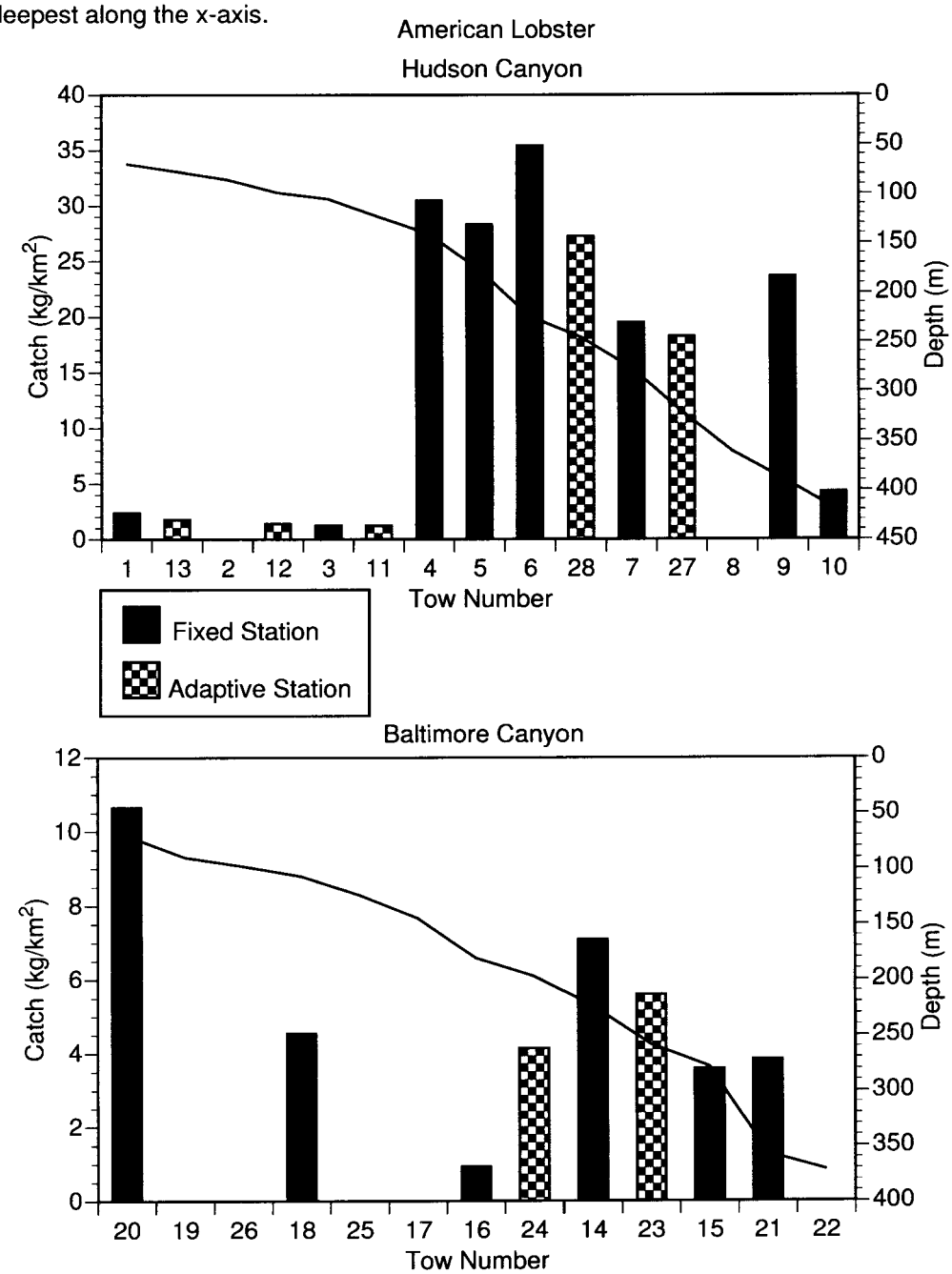


Figure 5b. Projected abundance of American lobster along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

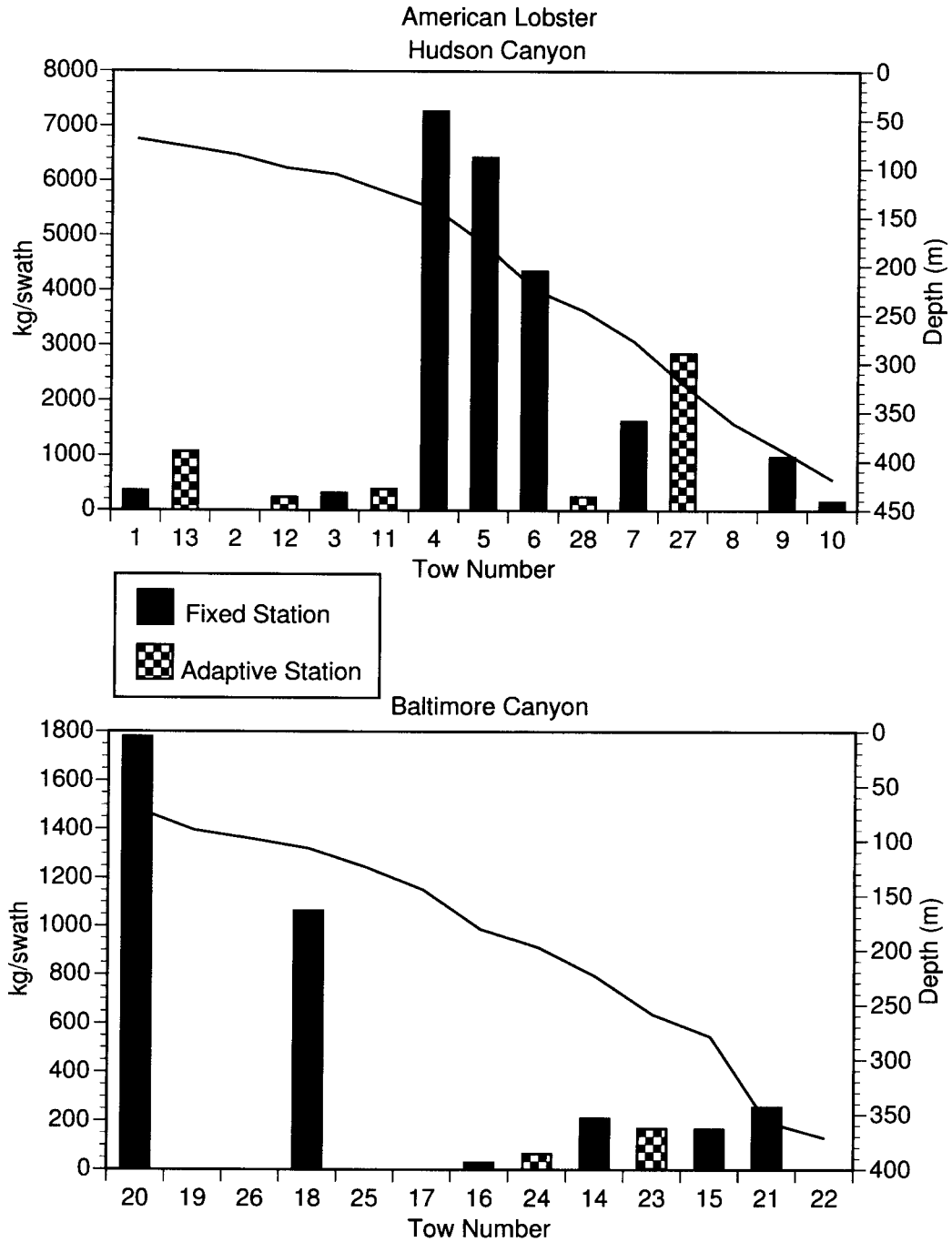


Figure 6a. Catches of Atlantic herring in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

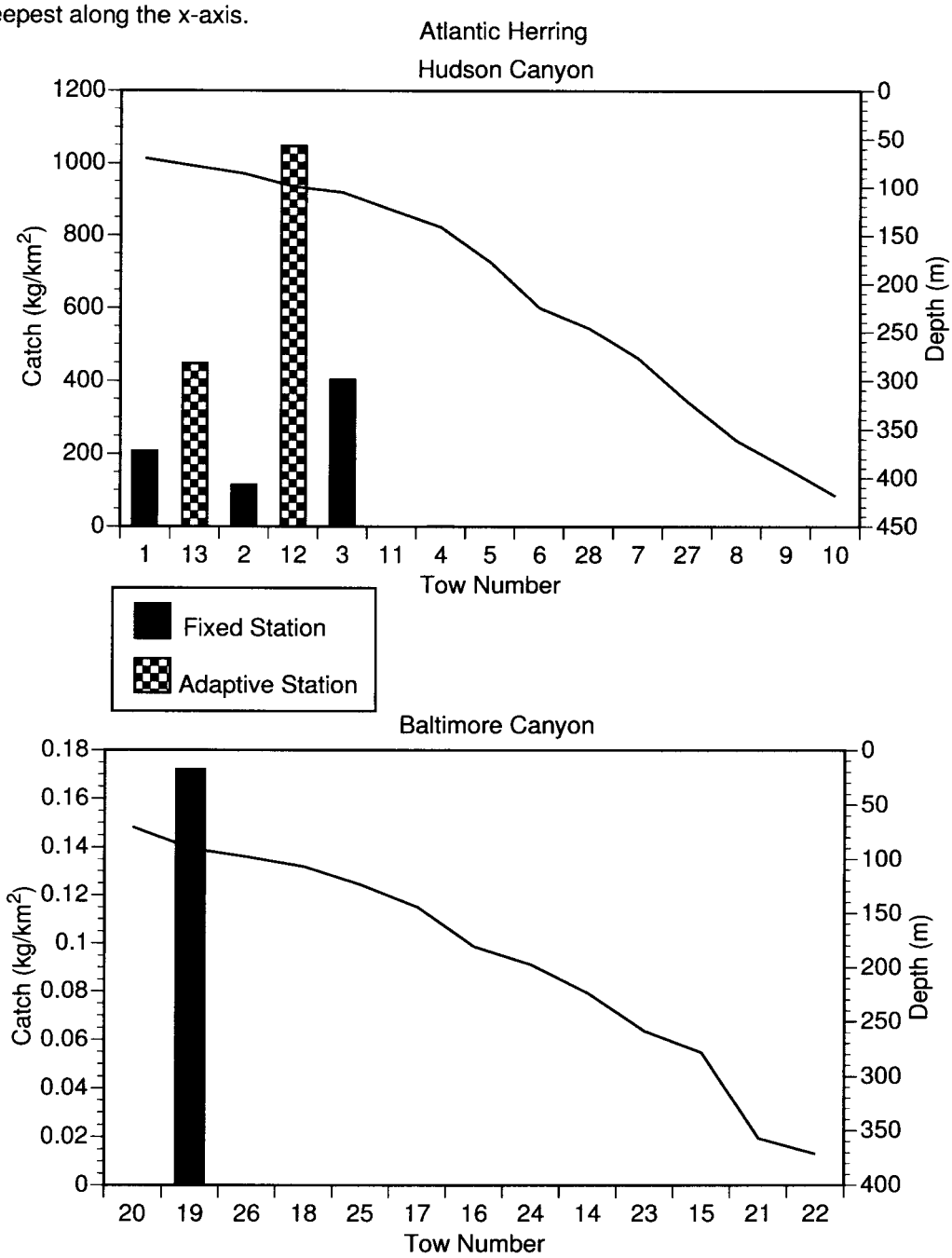


Figure 6b. Projected abundance of Atlantic herring along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

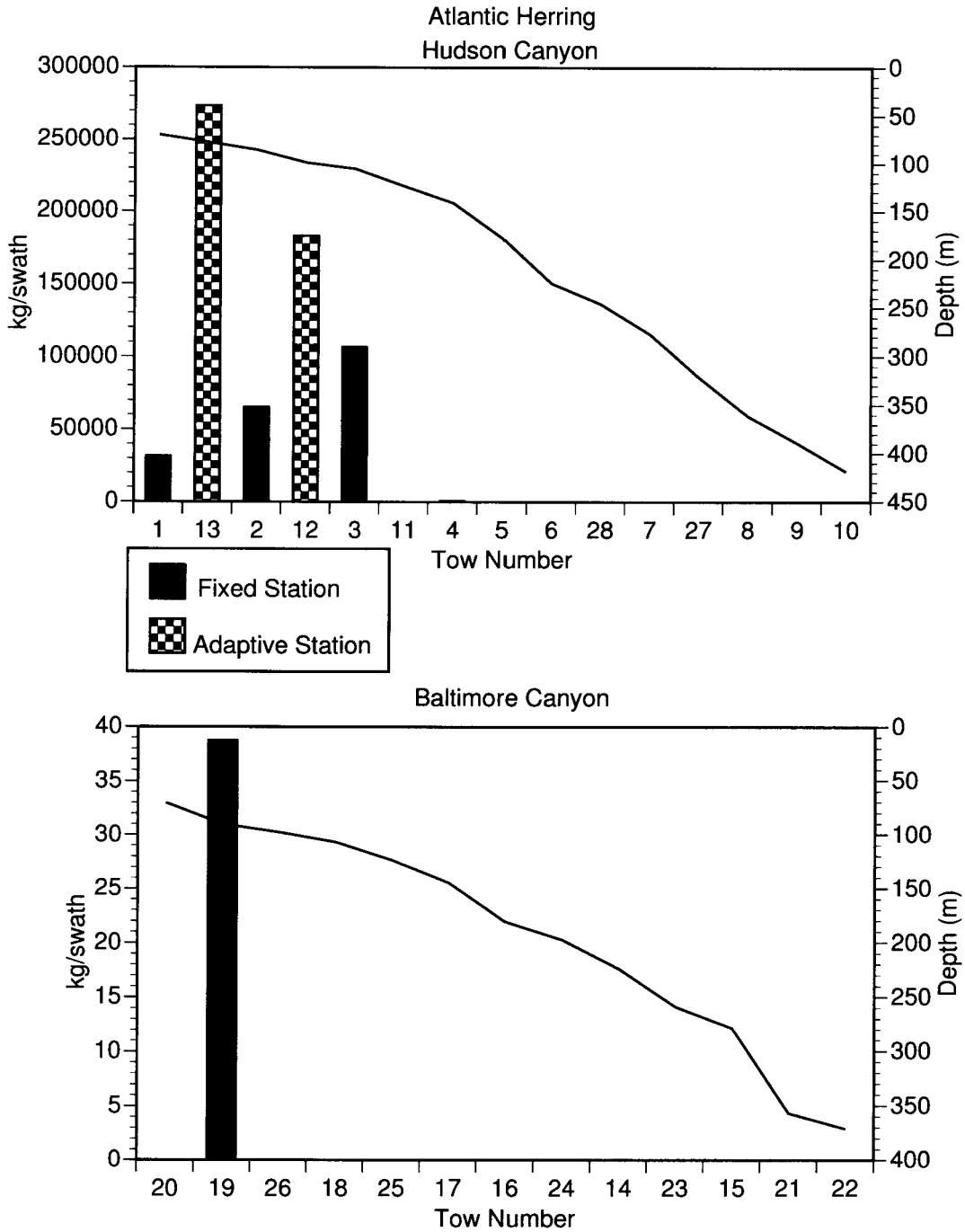


Figure 7a. Catches of Atlantic mackerel in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

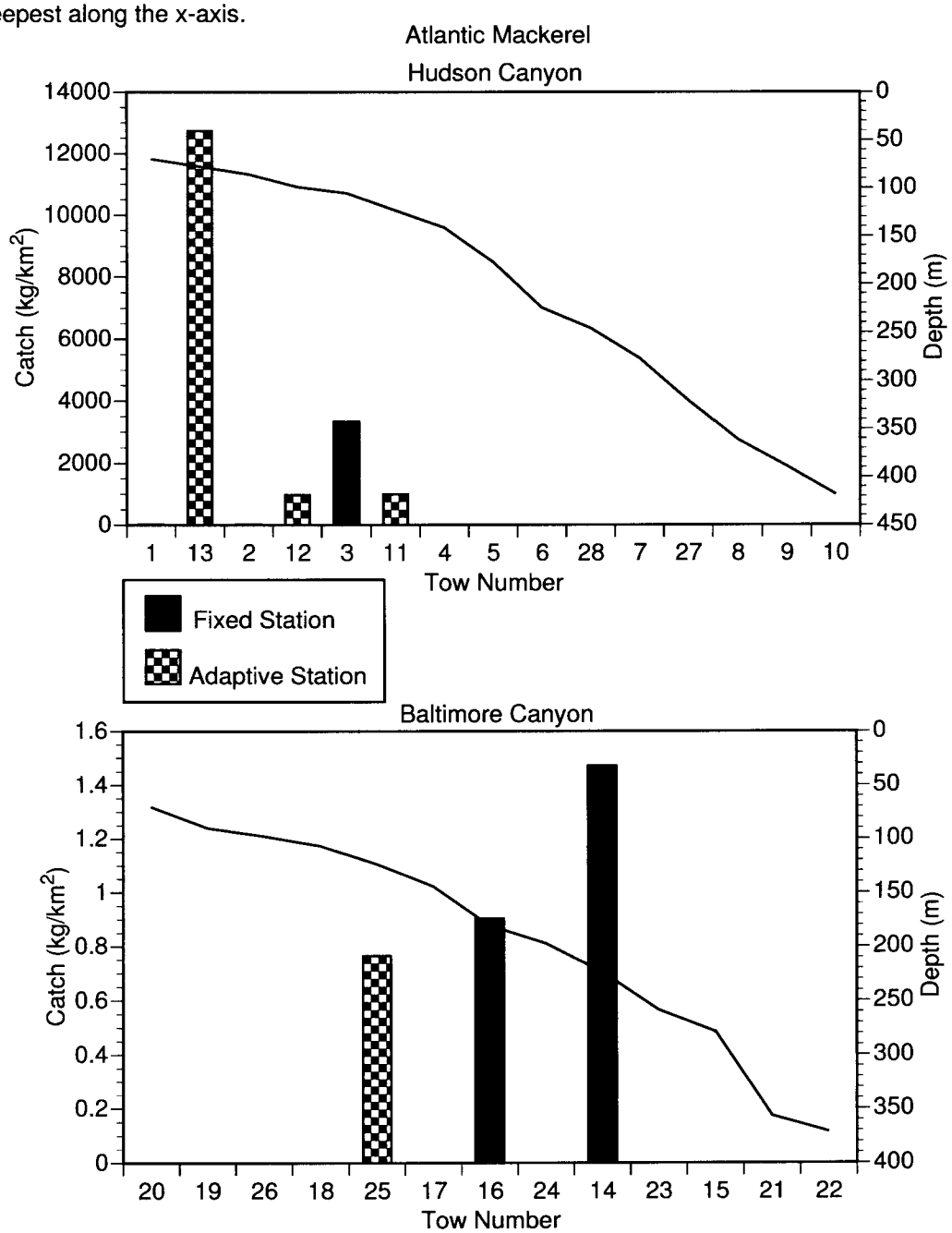


Figure 7b. Projected abundance of Atlantic mackerel along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

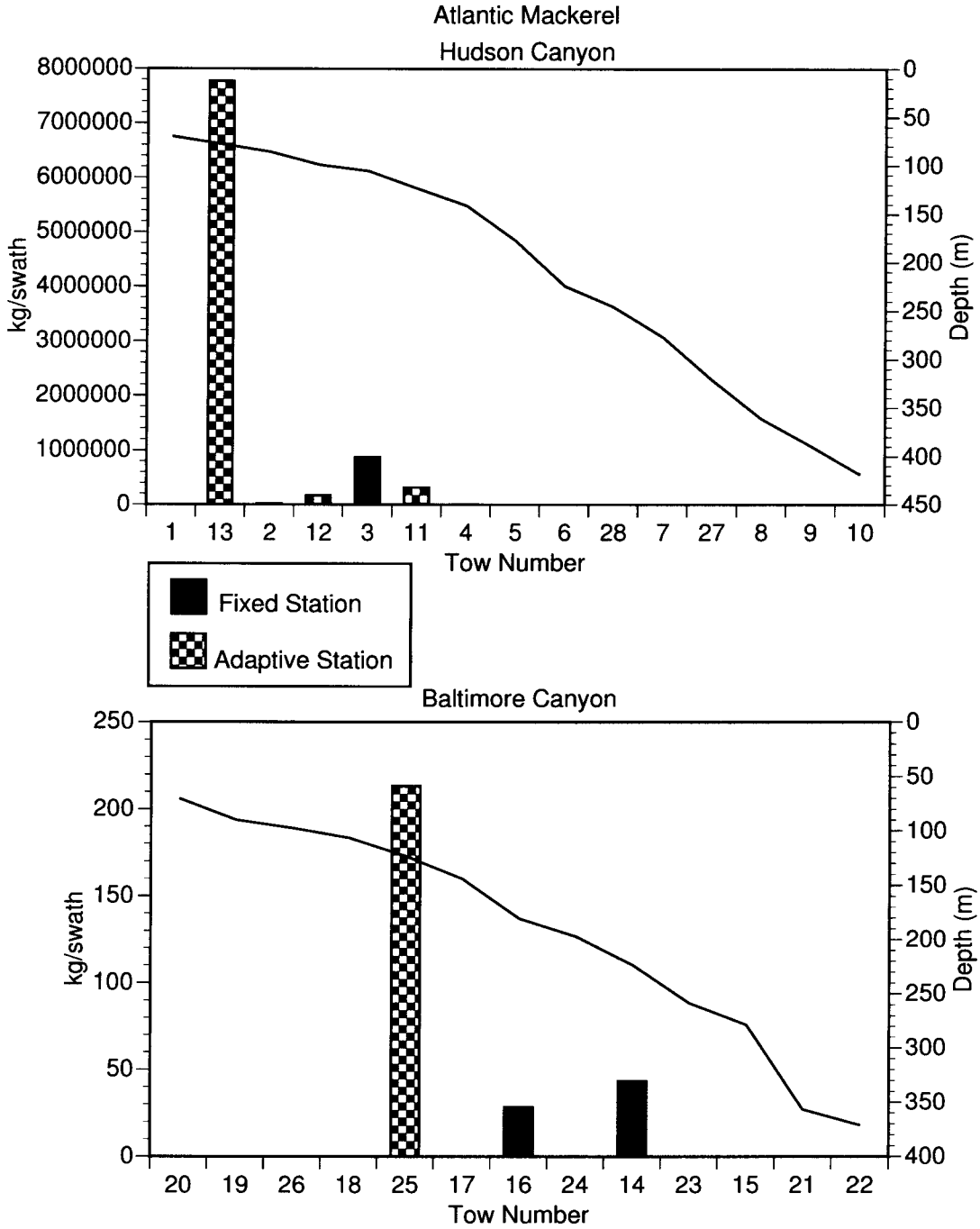


Figure 8a. Catches of black sea bass in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

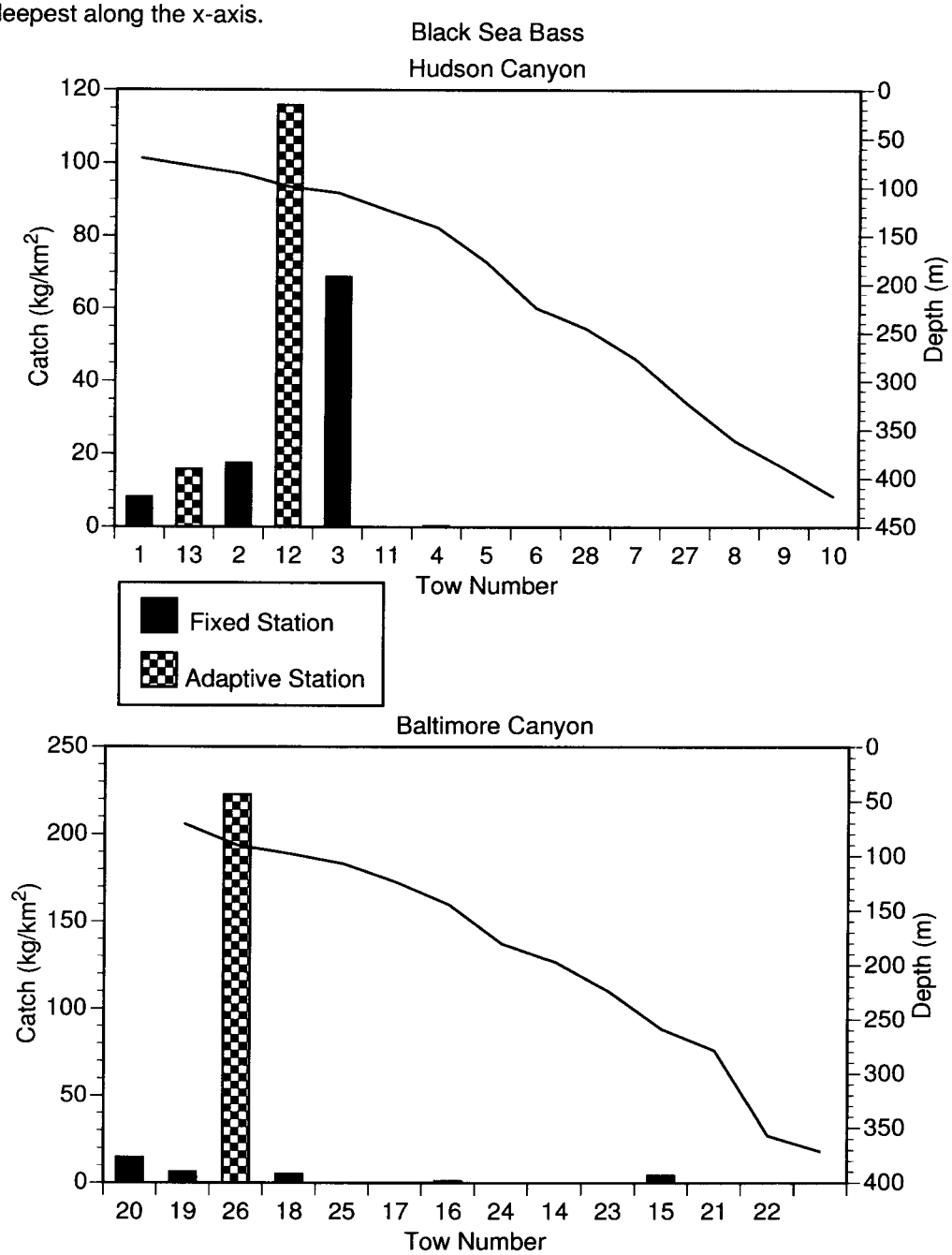


Figure 8b. Projected abundance of black sea bass along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

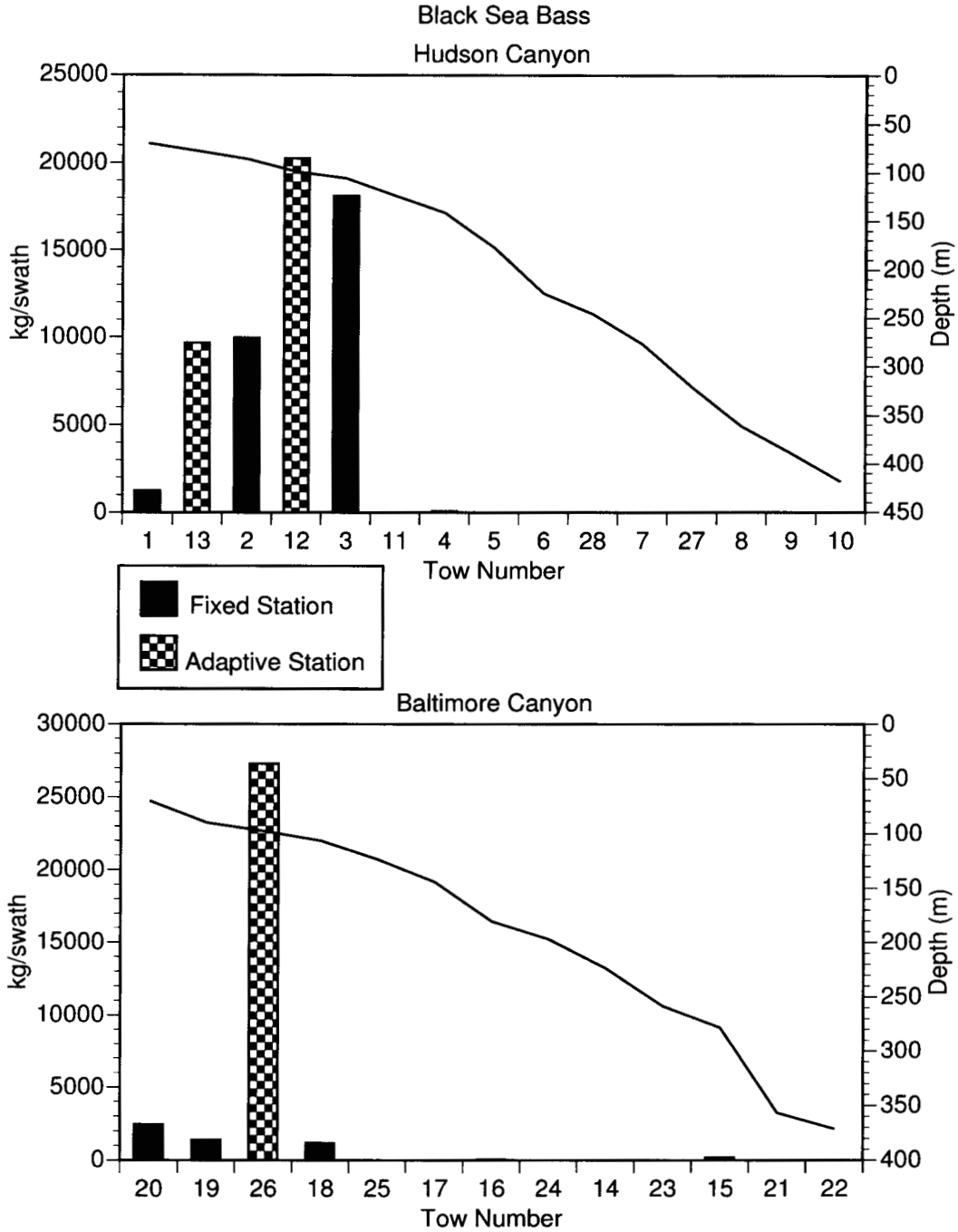


Figure 9a. Catches of butterfish in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

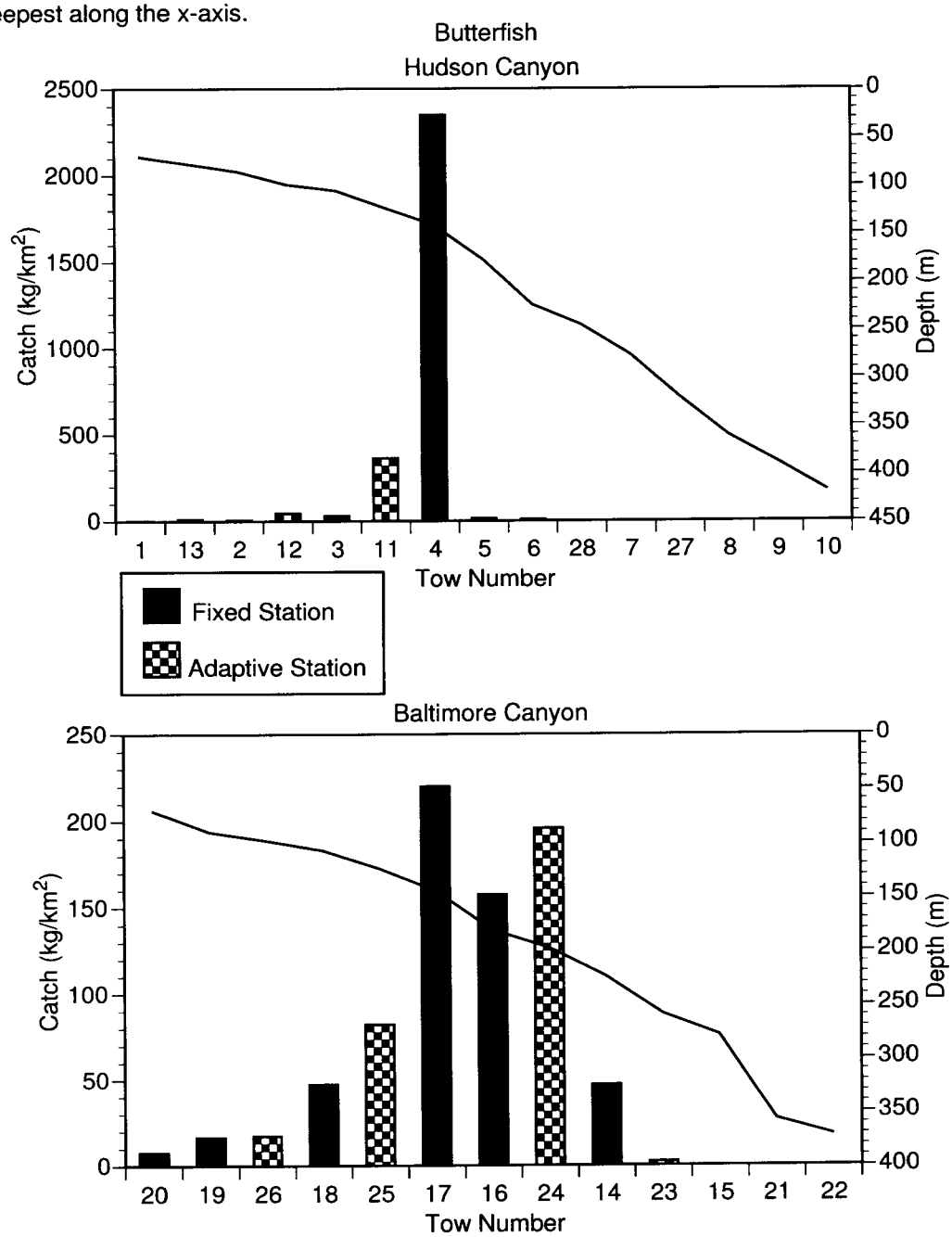


Figure 9b. Projected abundance of butterfish along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

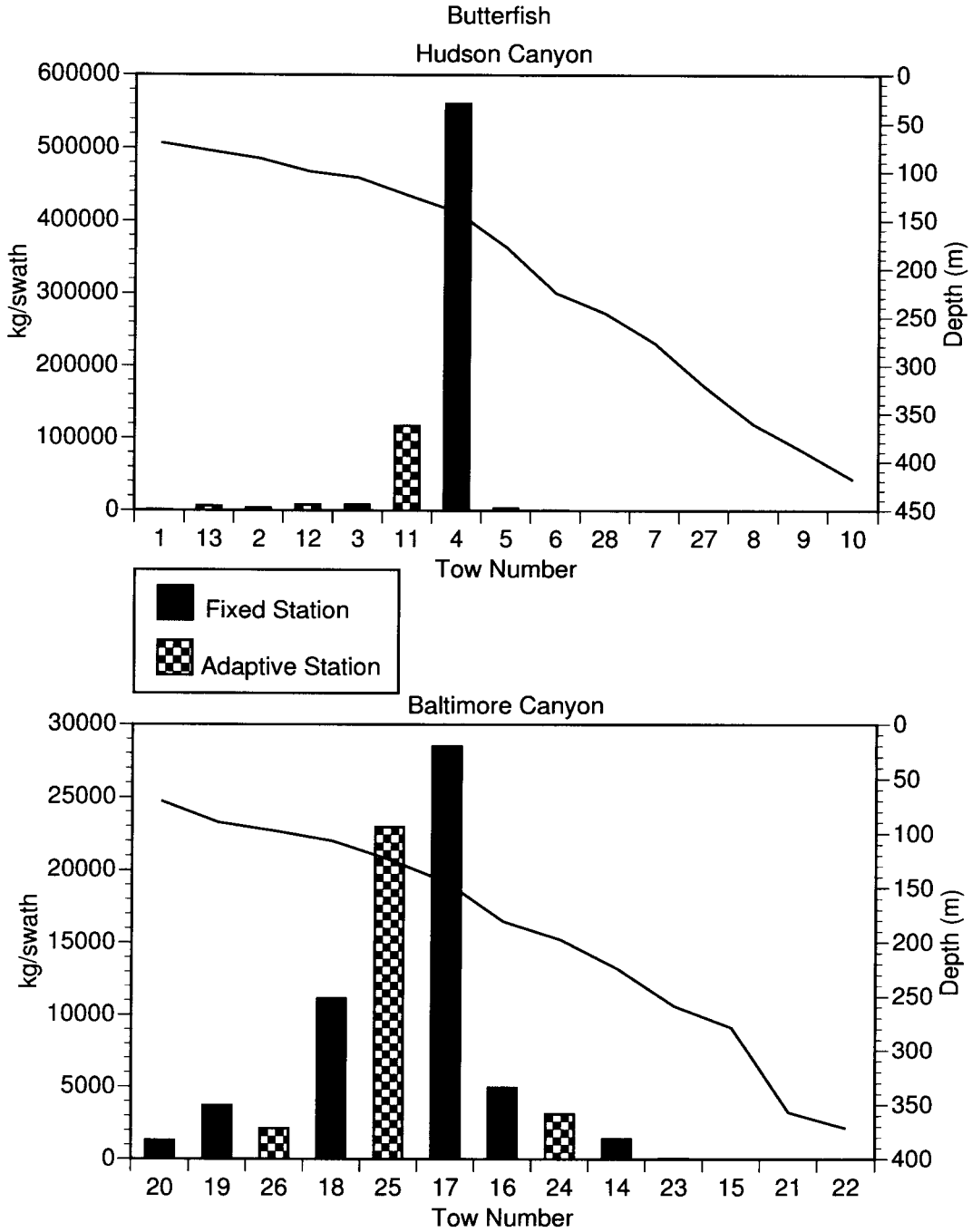


Figure 10a. Catches of fourspot flounder in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

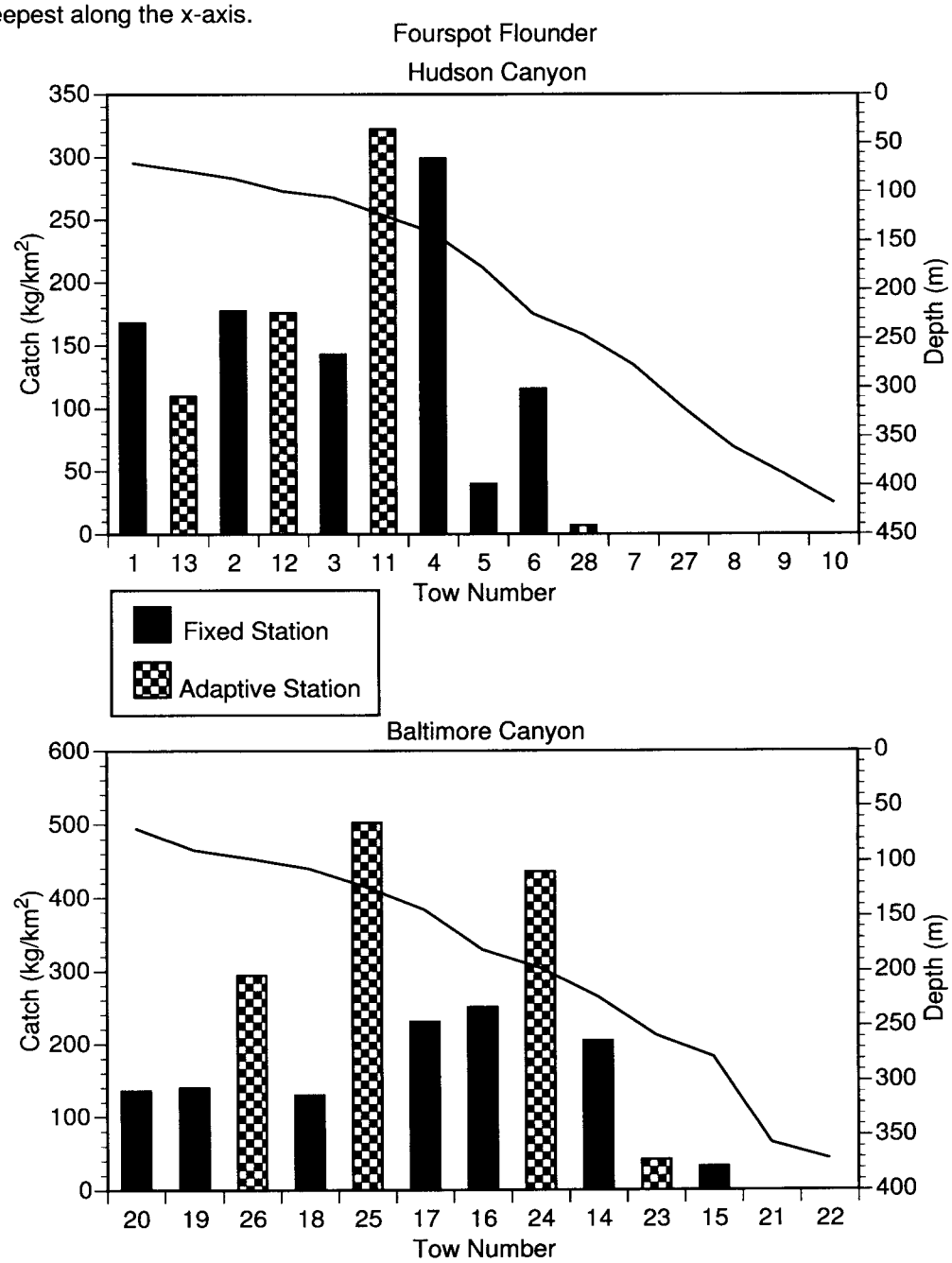


Figure 10b. Projected abundance of fourspot flounder along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

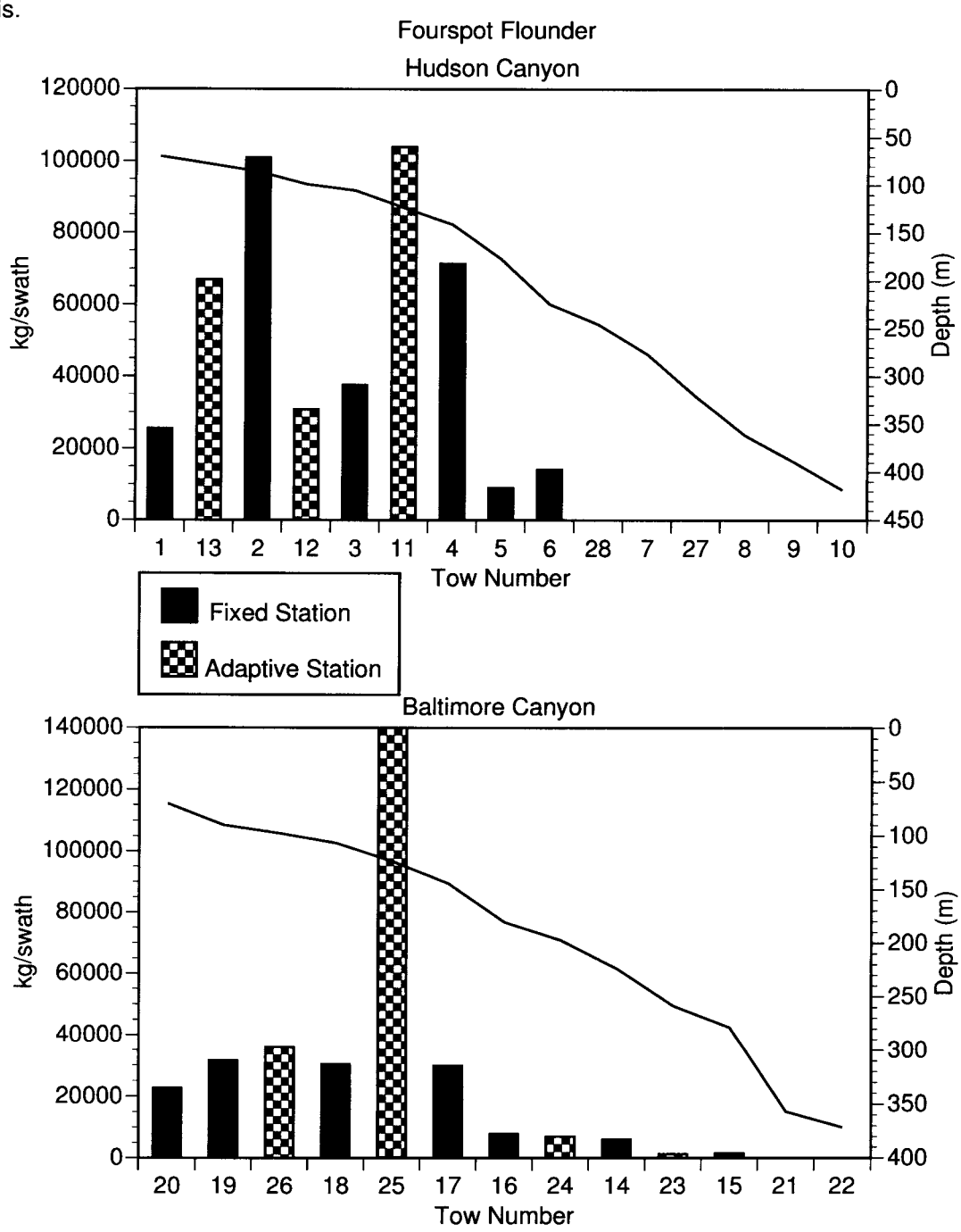


Figure 11a. Catches of *Illex* squid in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

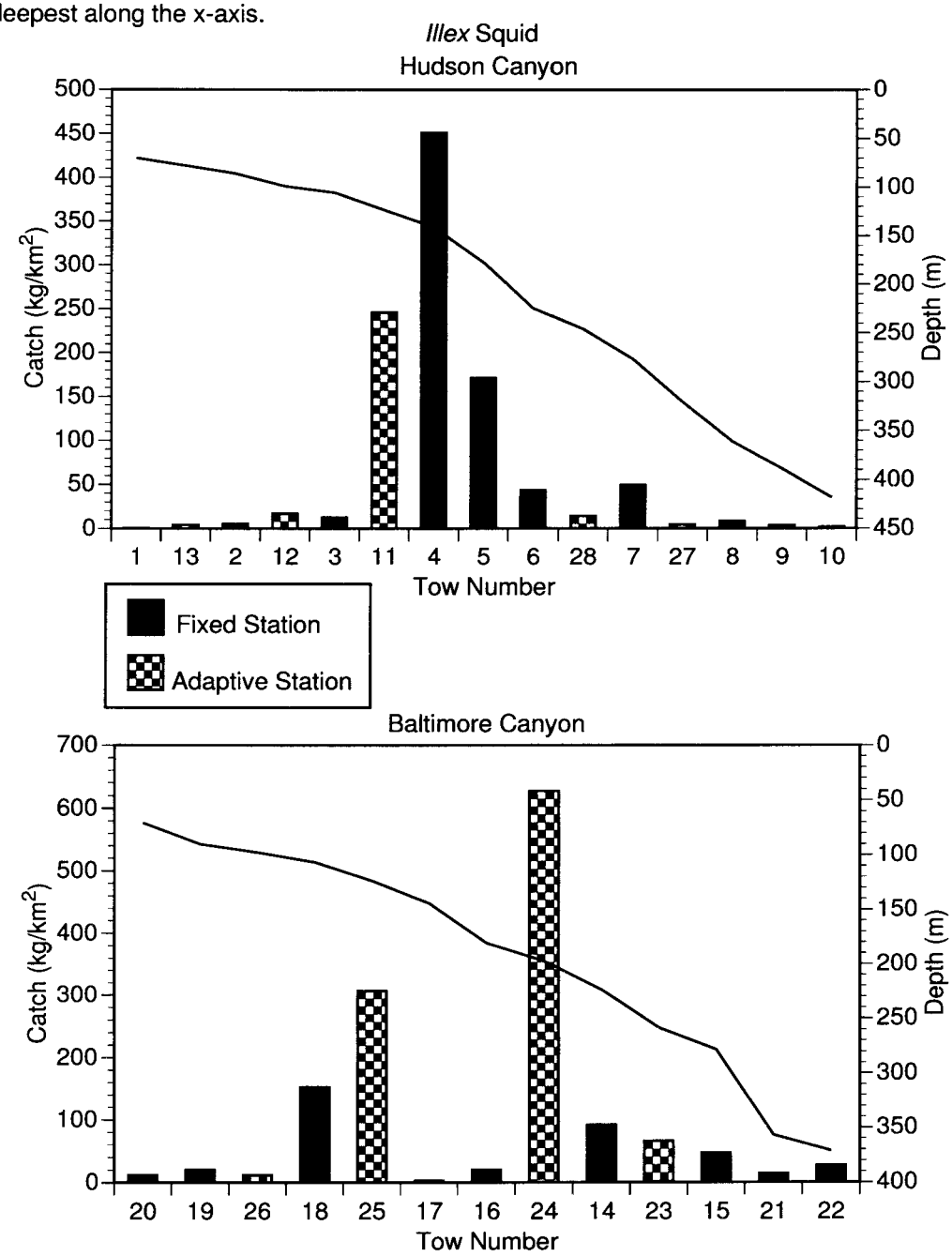


Figure 11b. Projected abundance of *Illex* squid along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

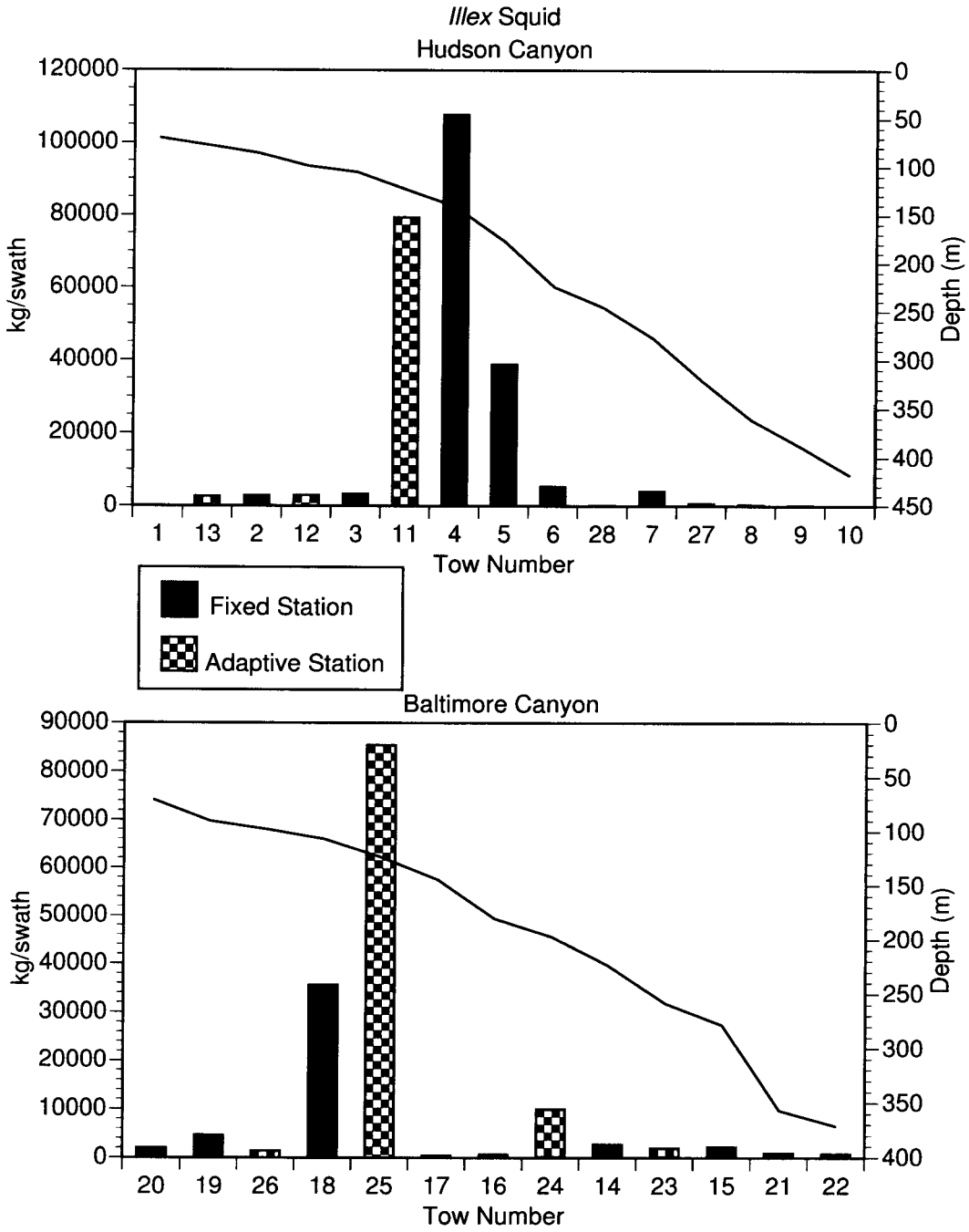


Figure 12a. Catches of Jonah crab in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

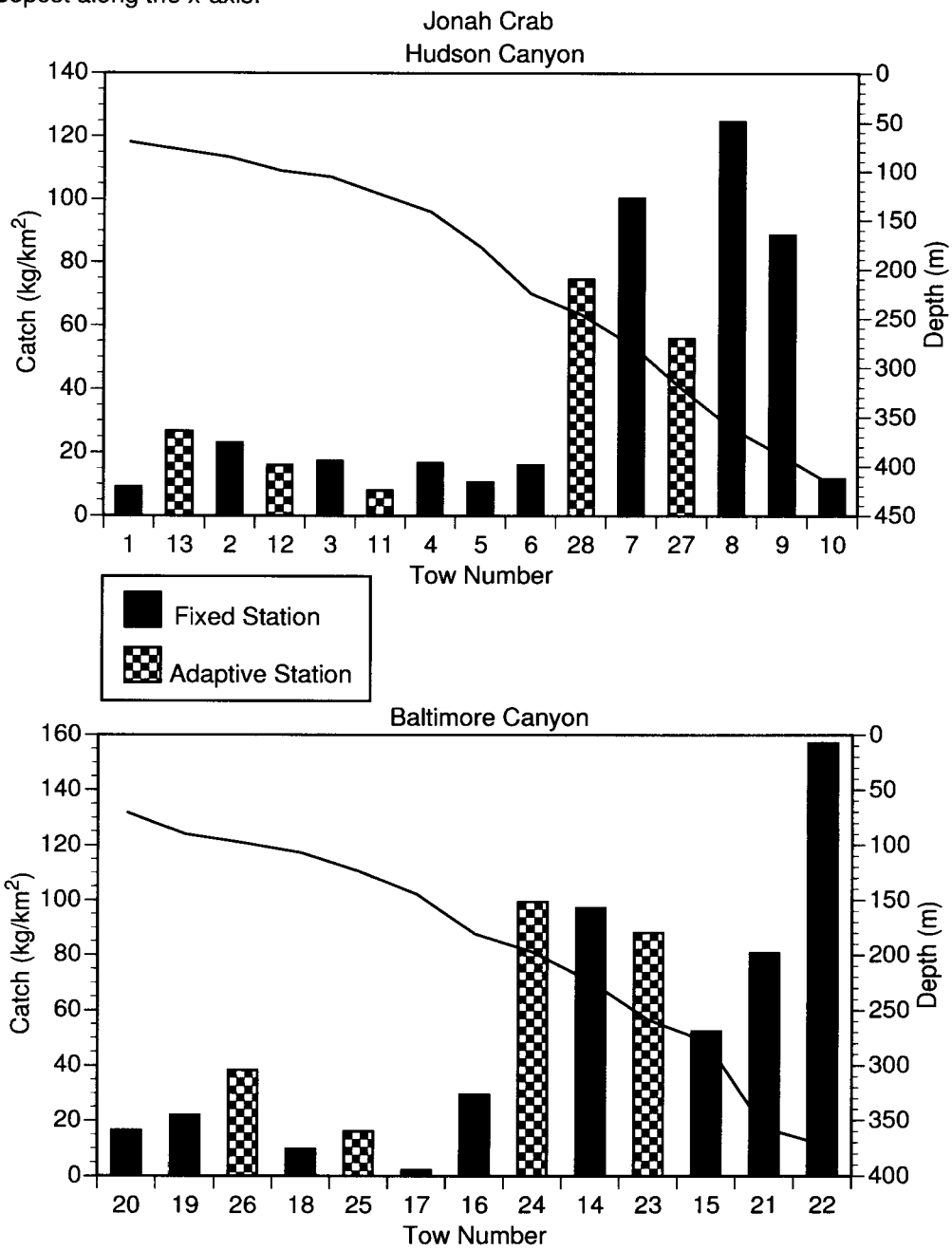


Figure 12b. Projected abundance of Jonah crab along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

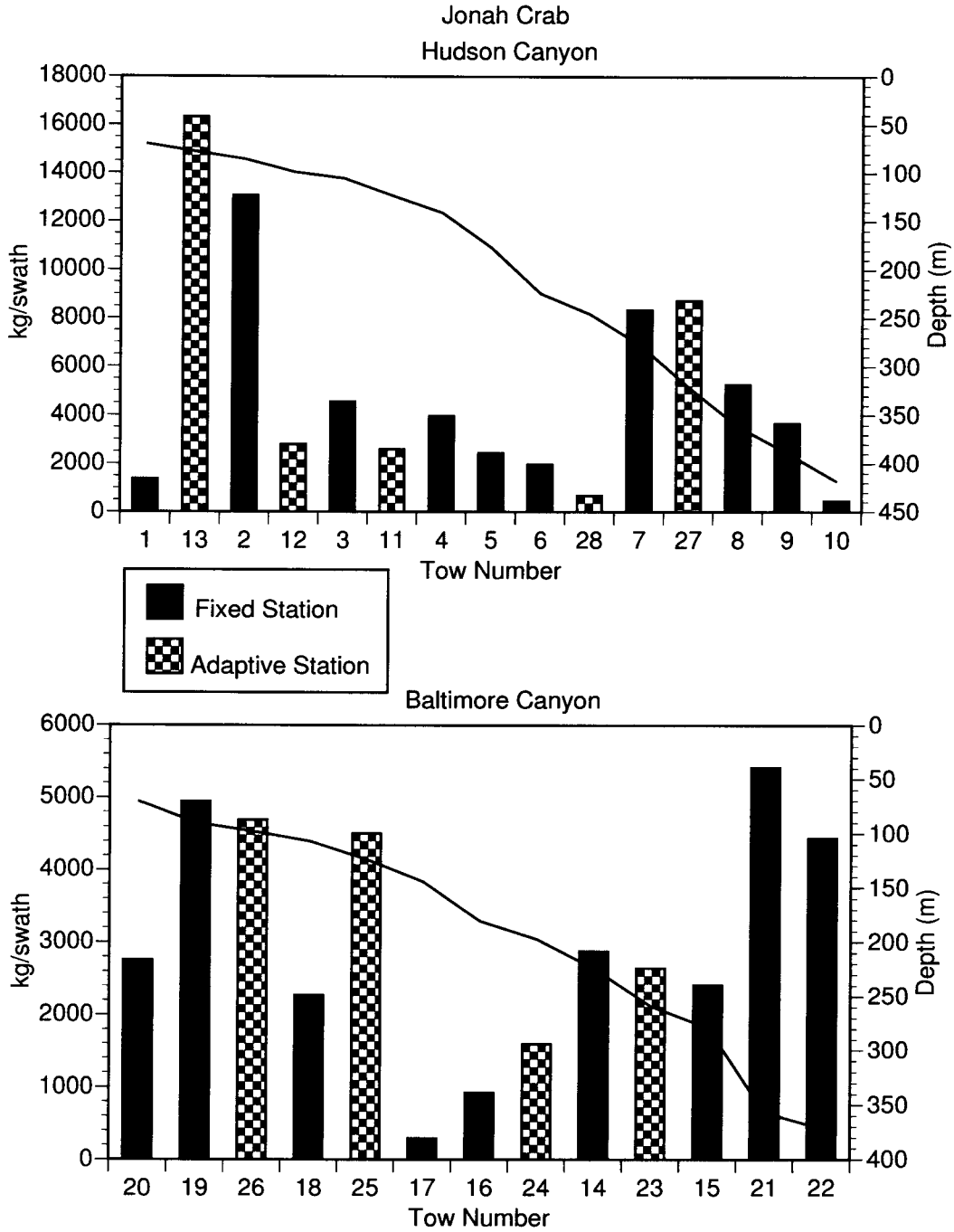


Figure 13a. Catches of little skate in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

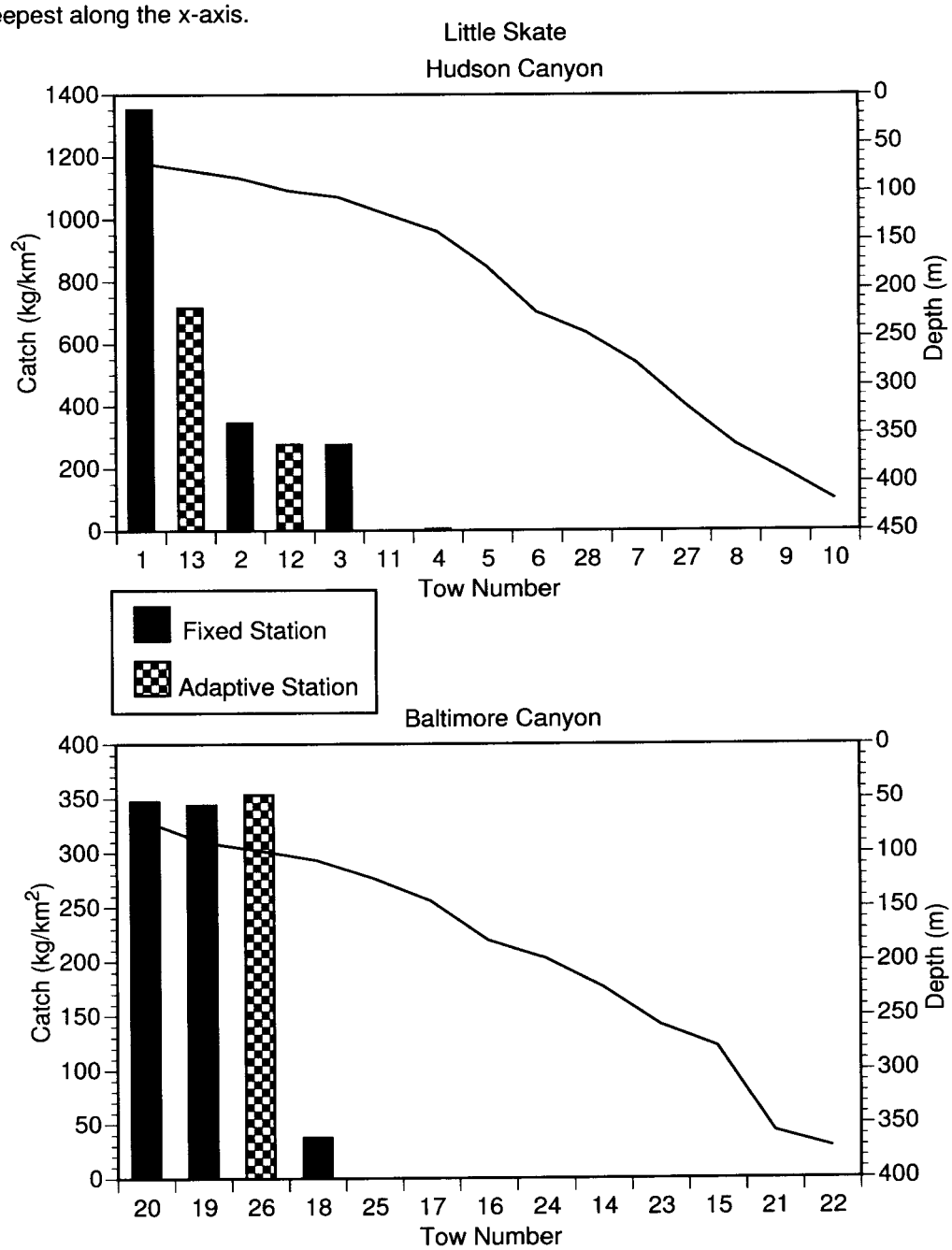


Figure 13b. Projected abundance of little skate along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

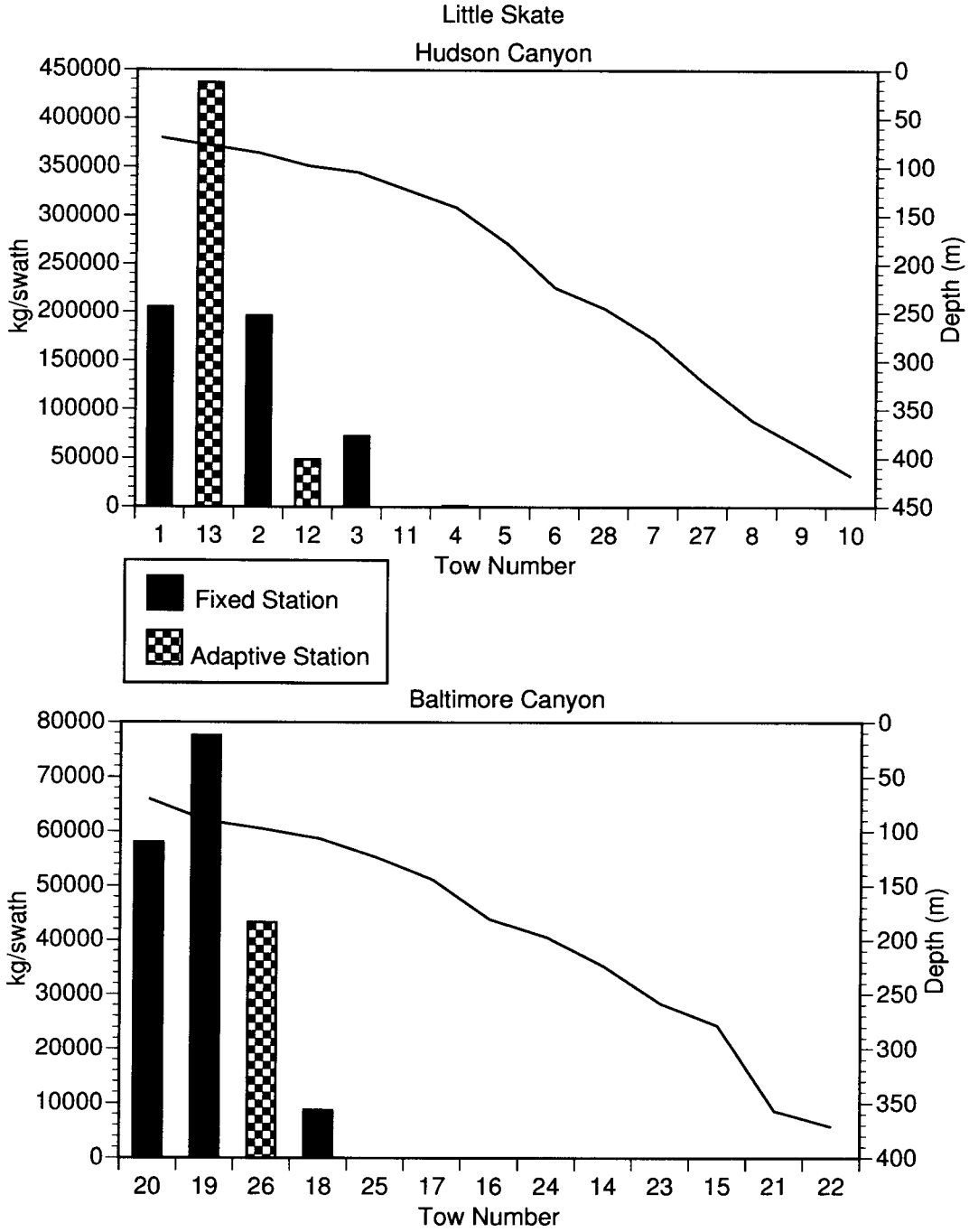


Figure 14a. Catches of *Loligo* squid in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

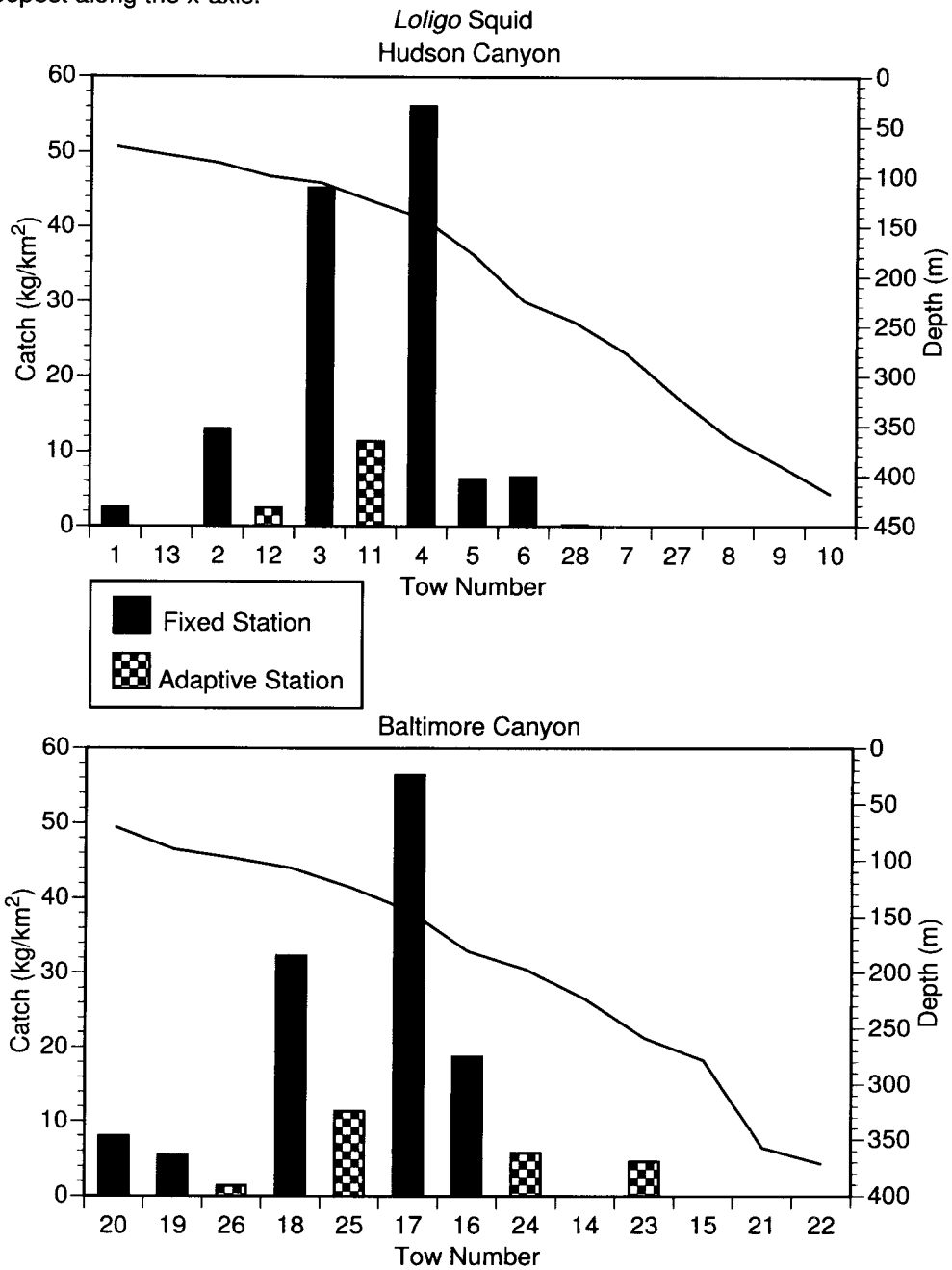


Figure 14b. Projected abundance of *Loligo* squid along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

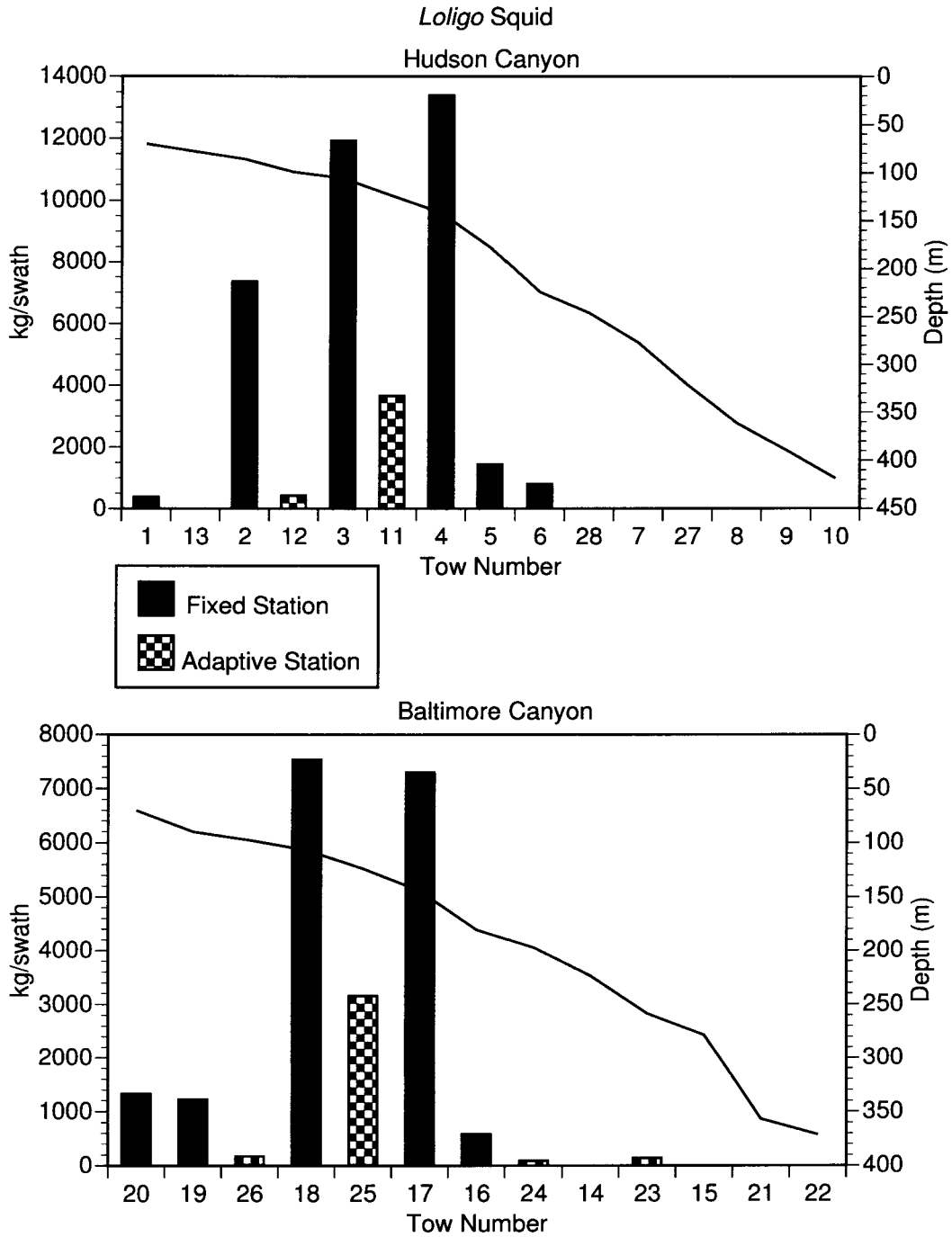


Figure 15a. Catches of monkfish in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

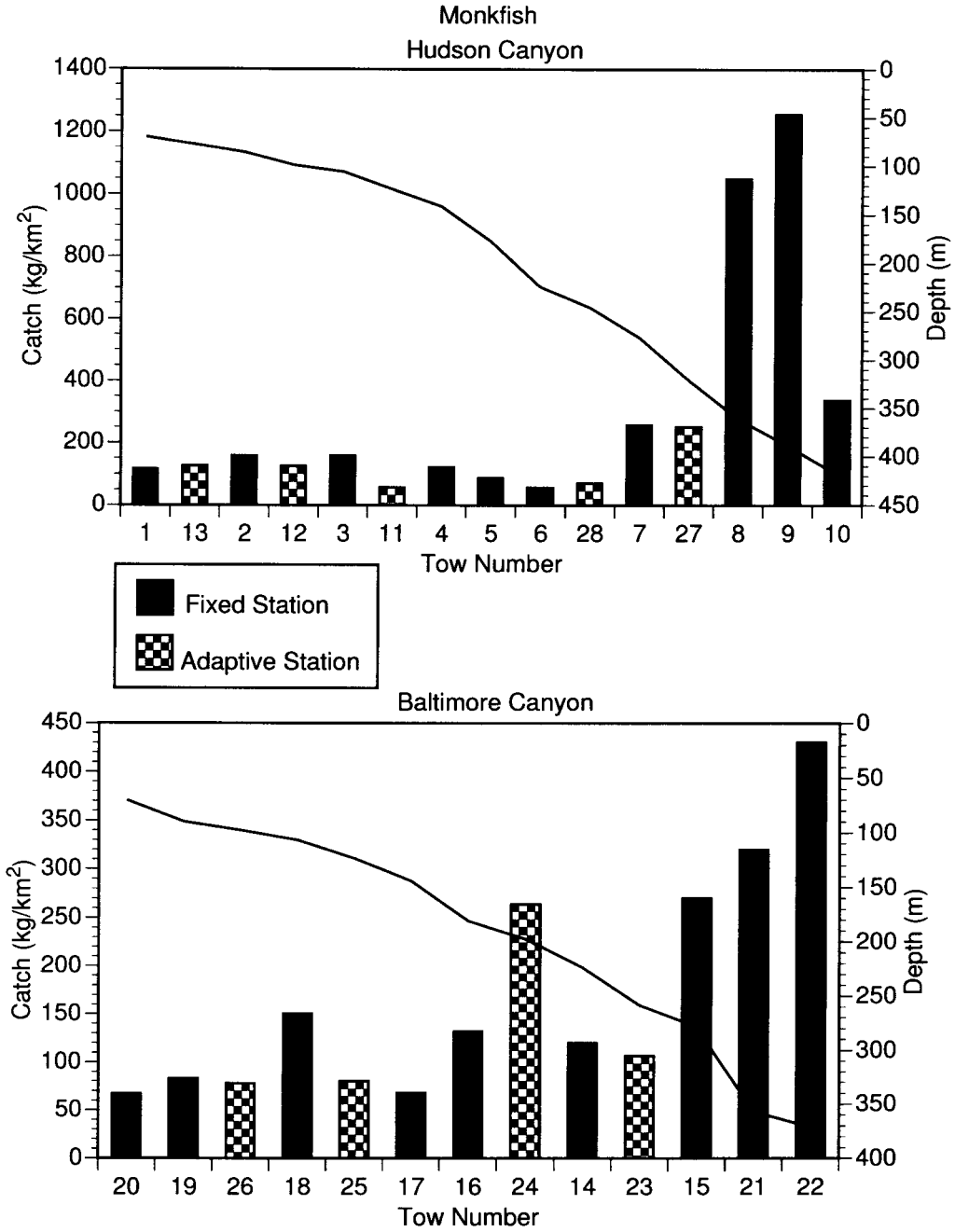


Figure 15b. Projected abundance of monkfish along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

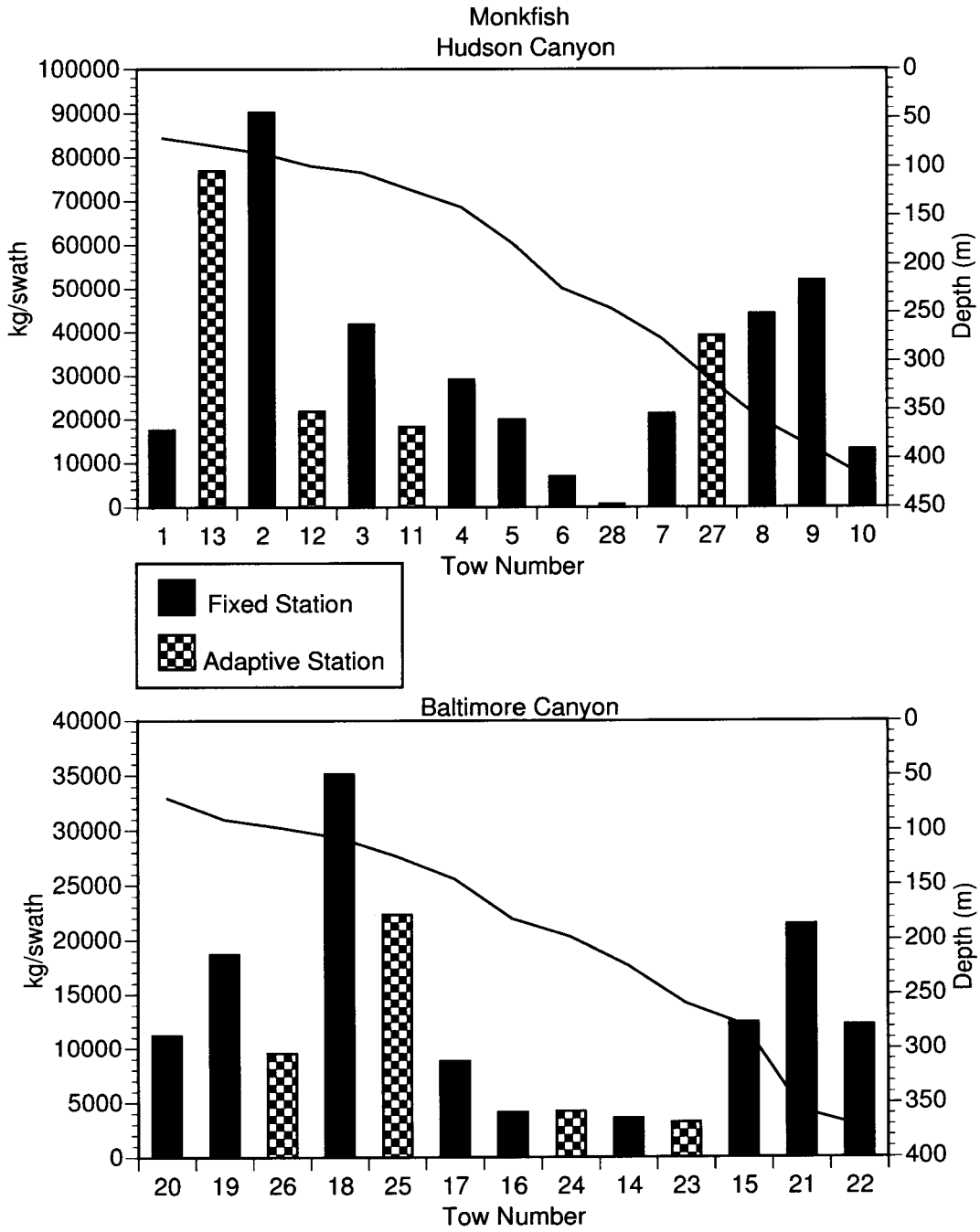


Figure 16a. Catches of offshore hake in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

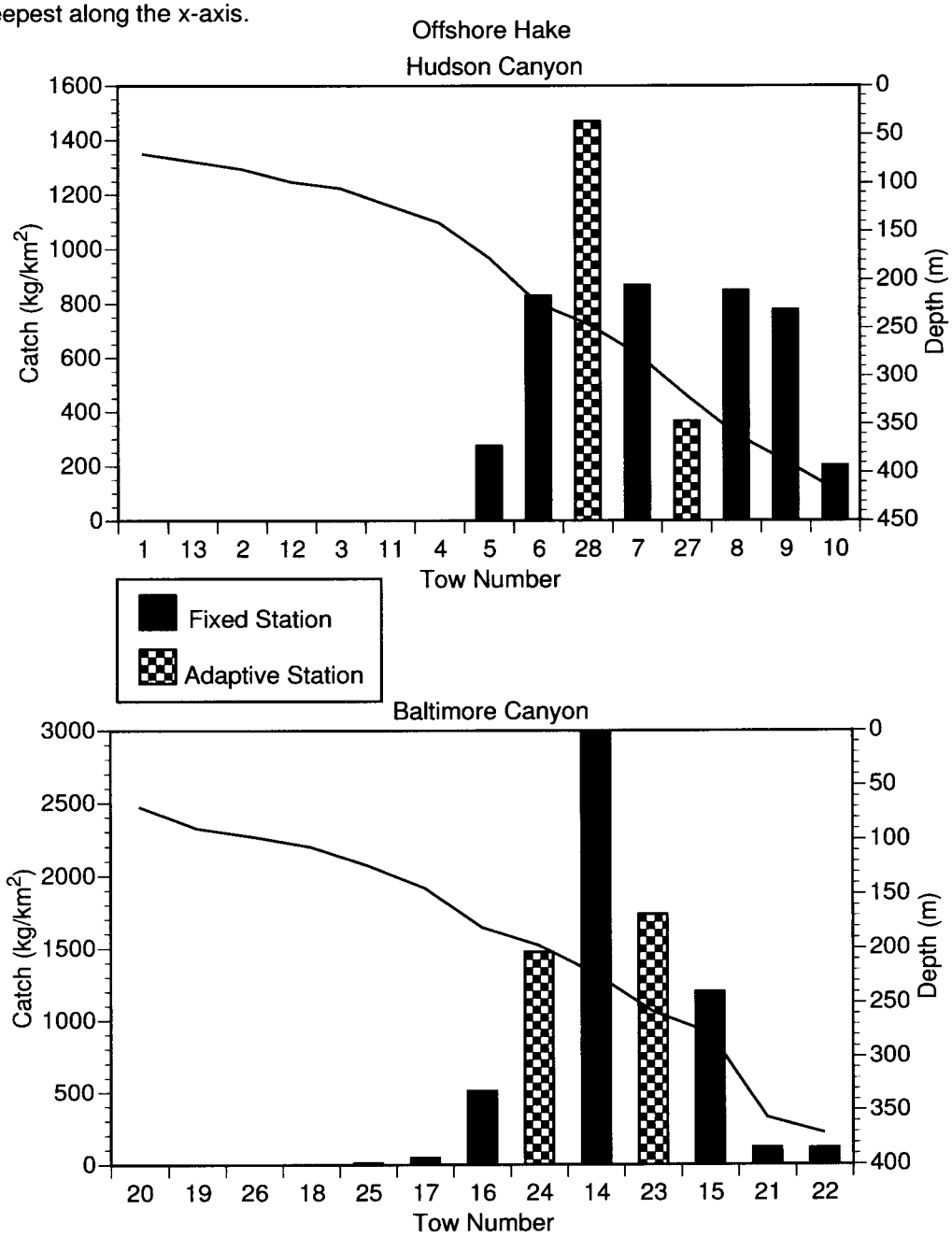


Figure 16b. Projected abundance of offshore hake along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

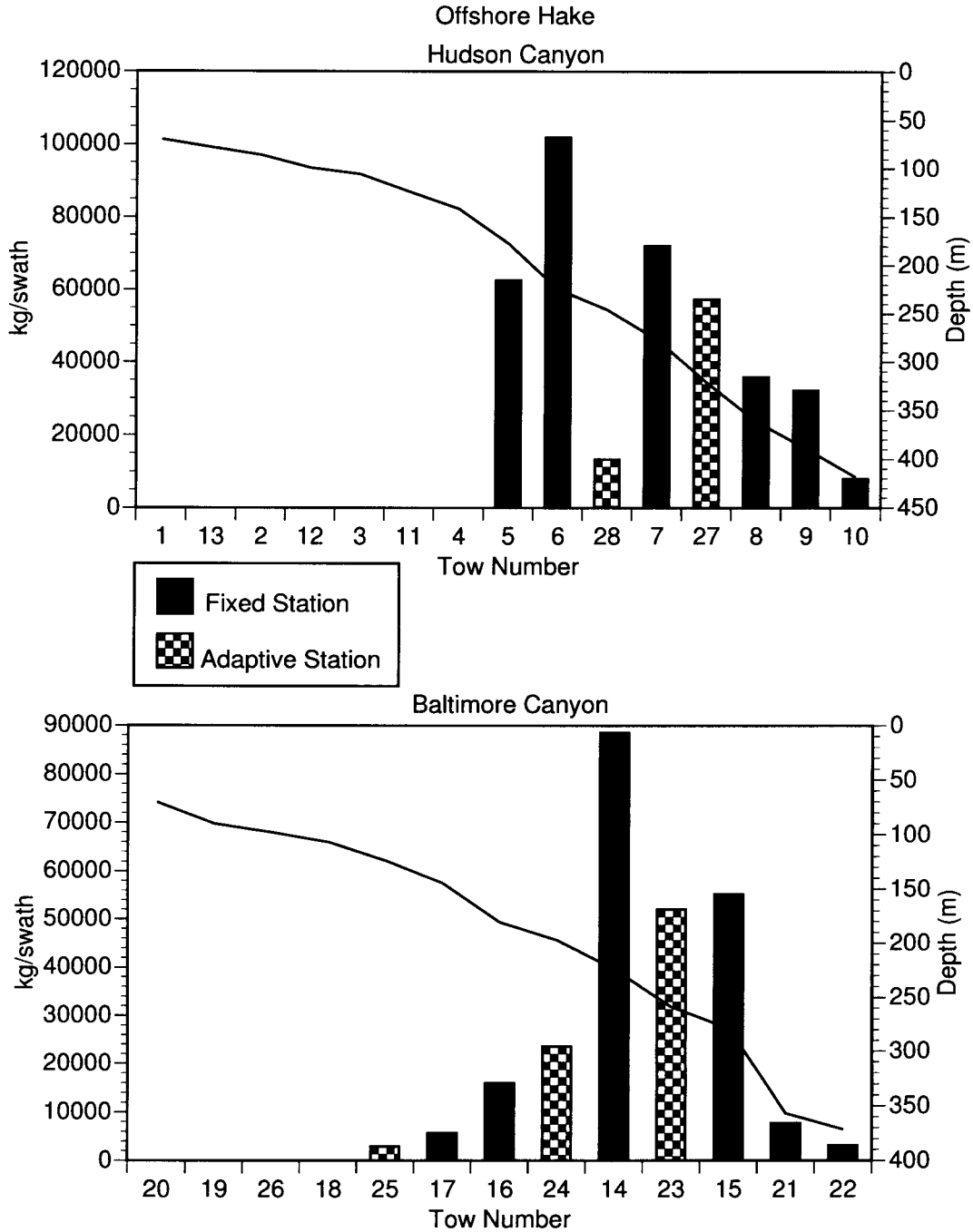


Figure 17a. Catches of deepsea red crab in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

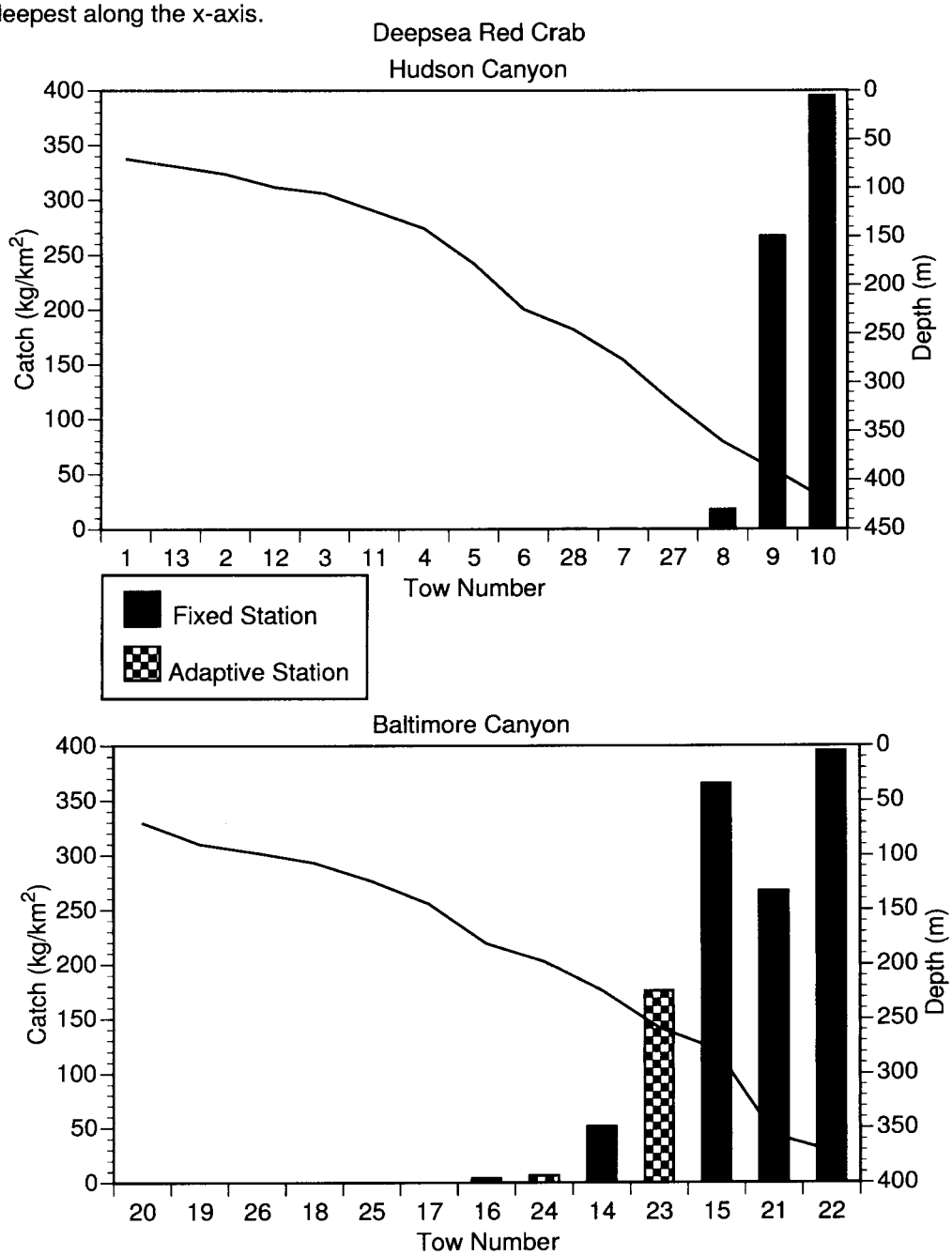


Figure 17b. Projected abundance of deepsea red crab along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

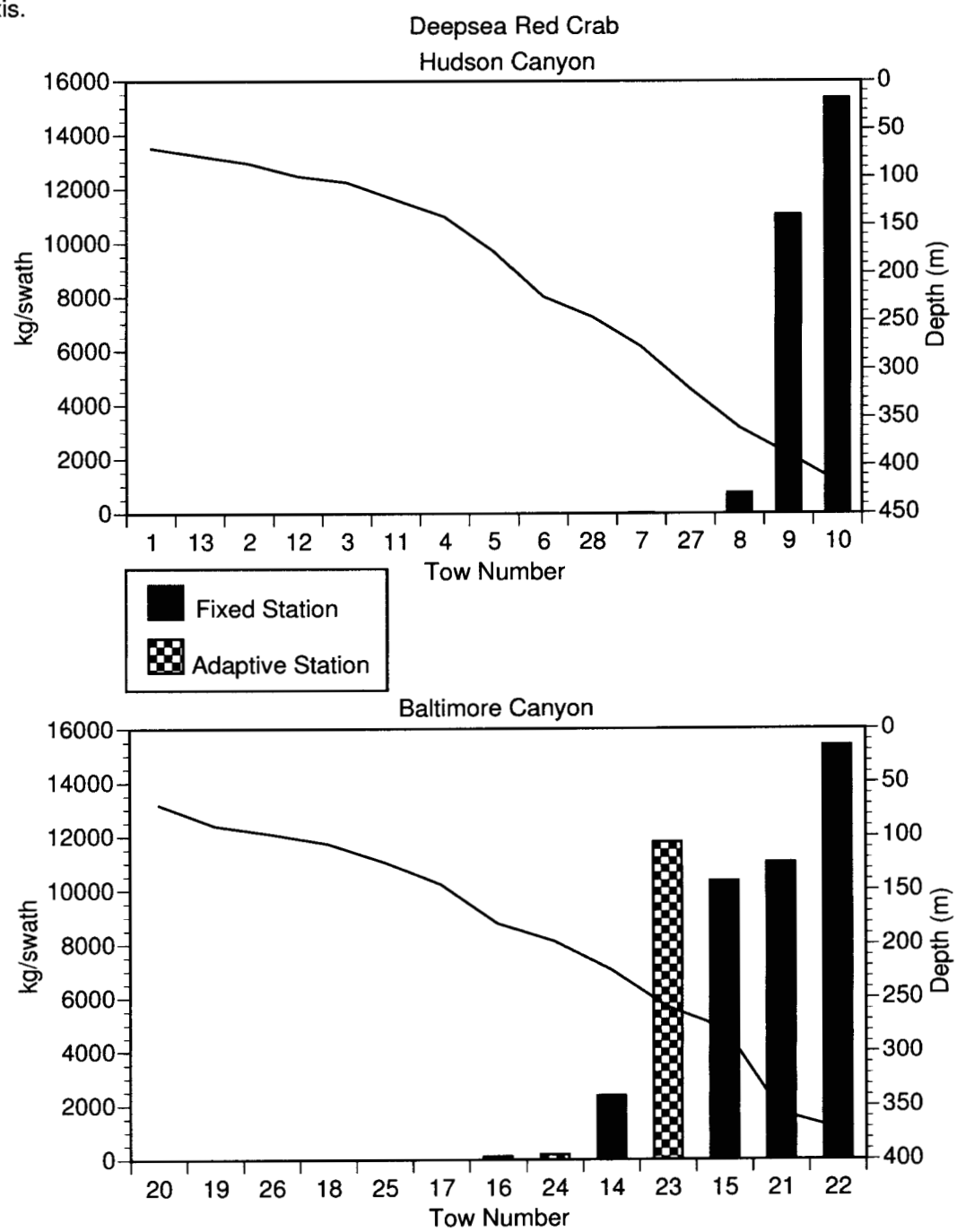


Figure 18a. Catches of scup in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

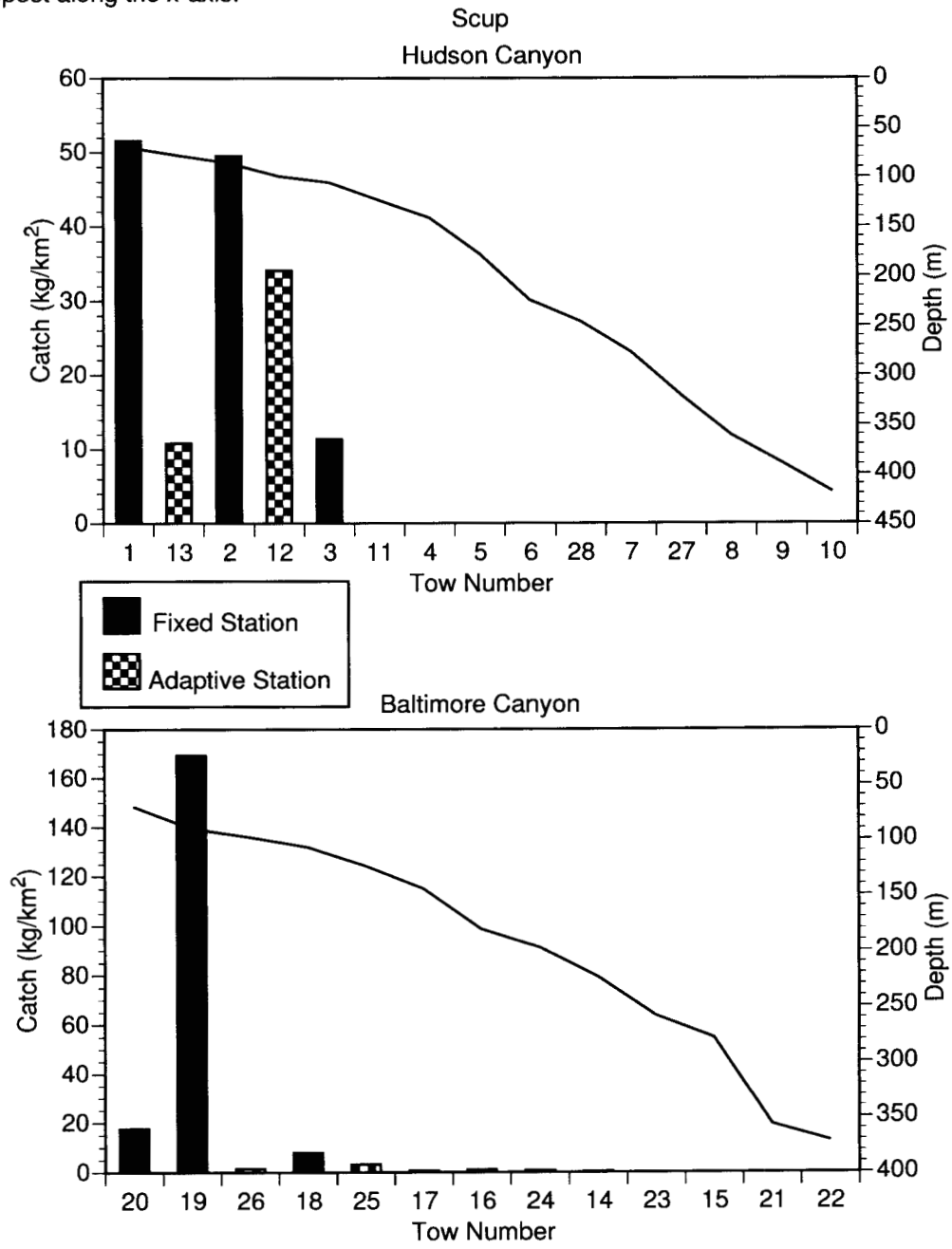


Figure 18b. Projected abundance of scup along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

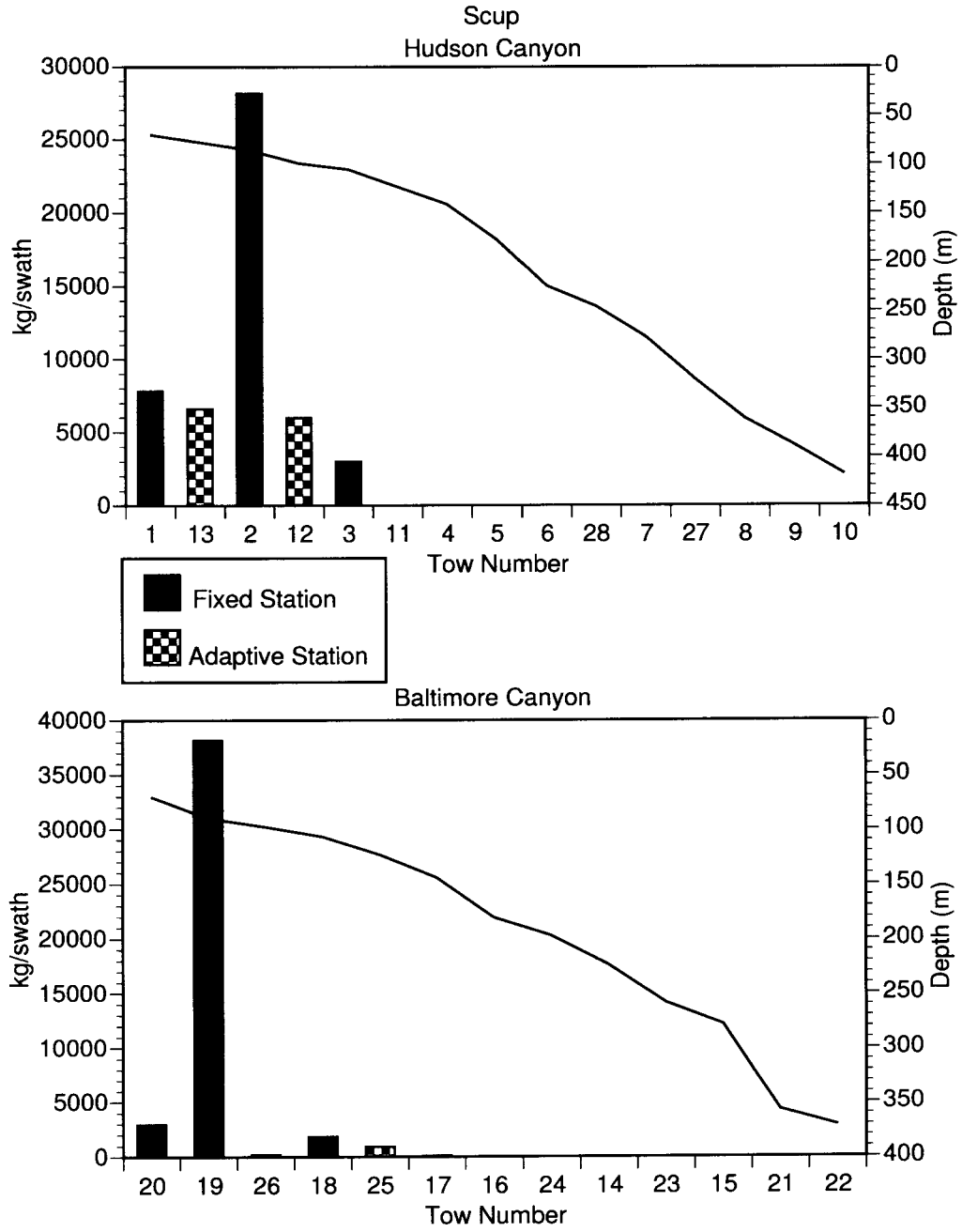


Figure 19a. Catches of silver hake in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

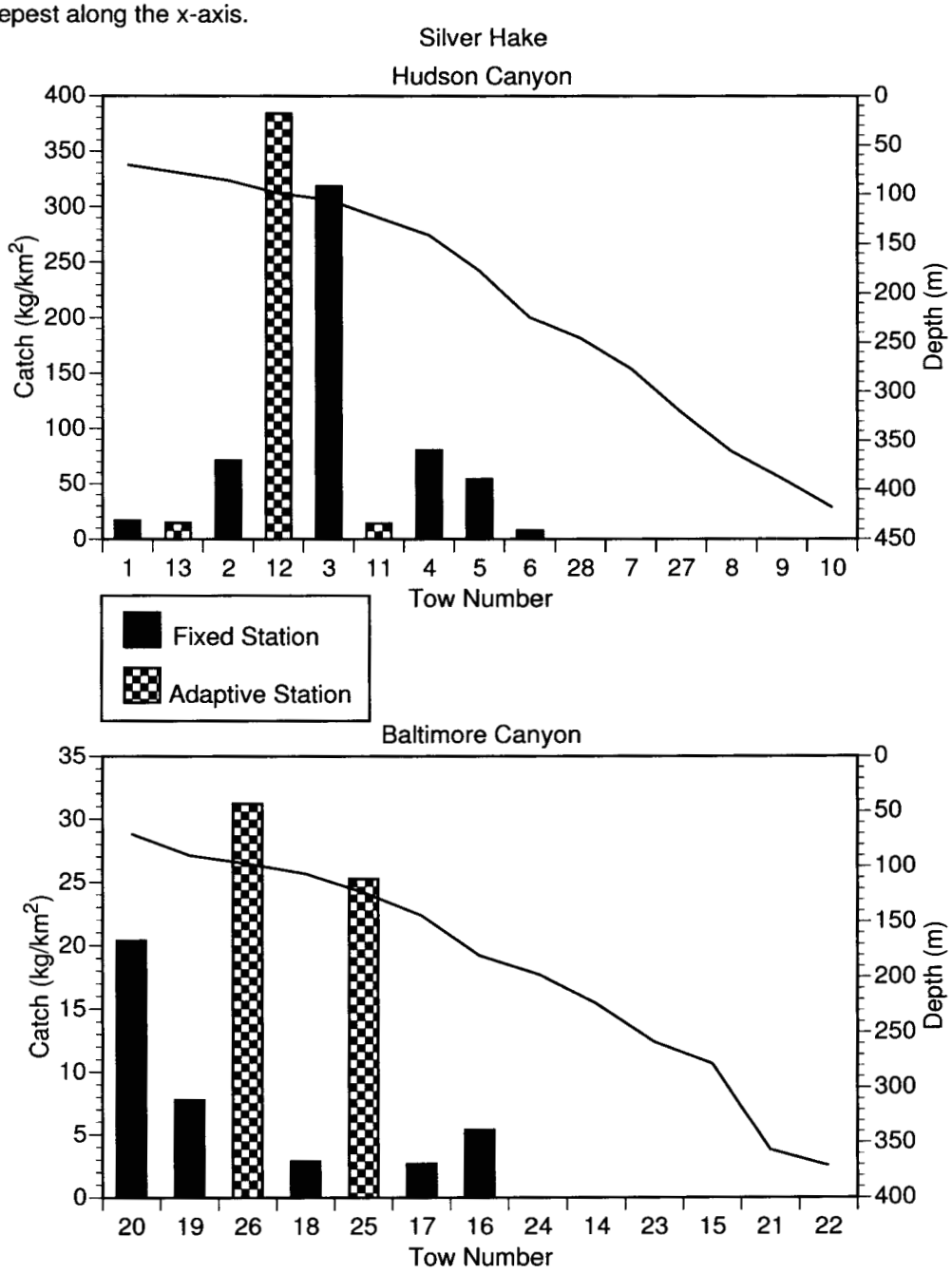


Figure 19b. Projected abundance of silver hake along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

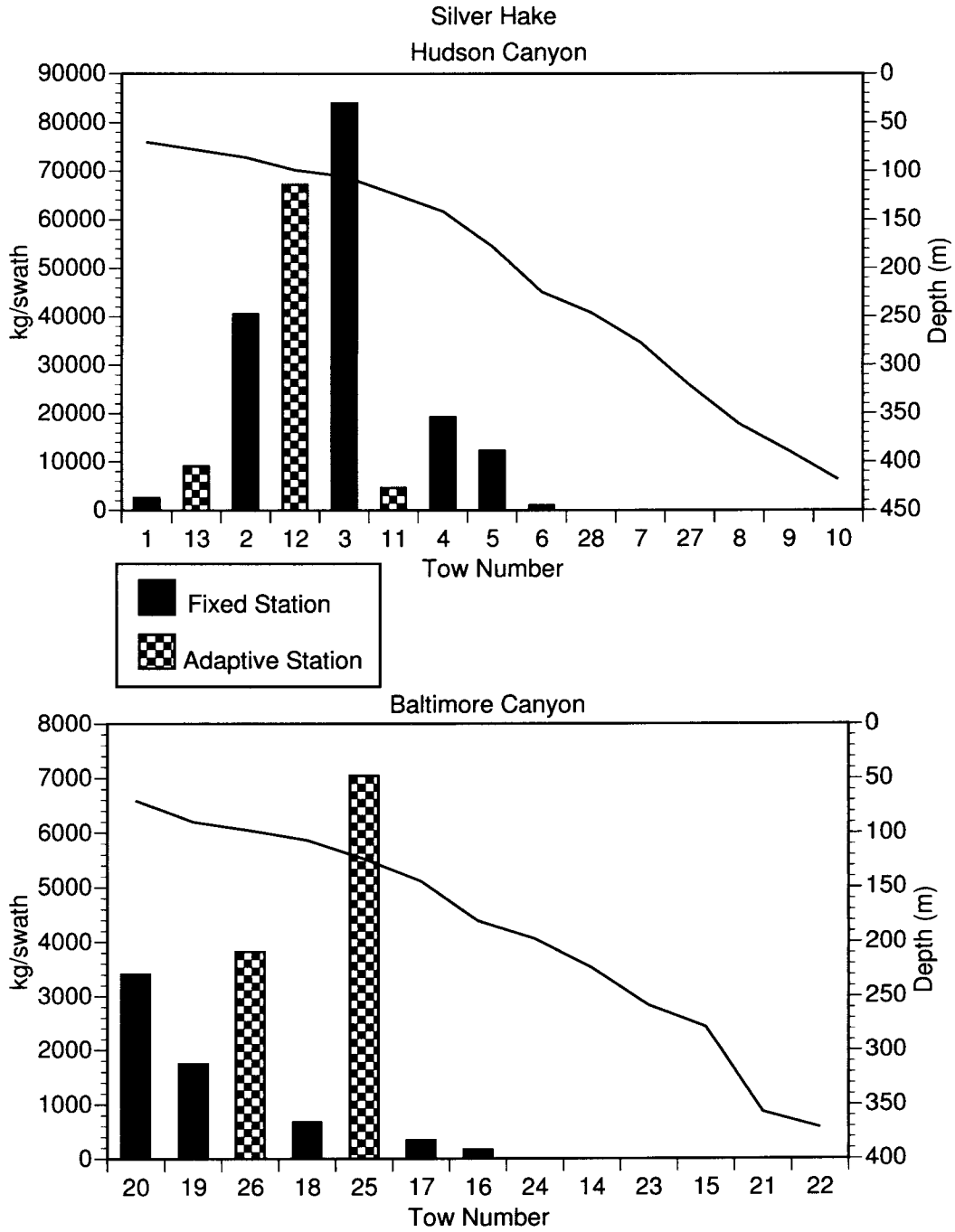


Figure 20a. Catches of smooth dogfish in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

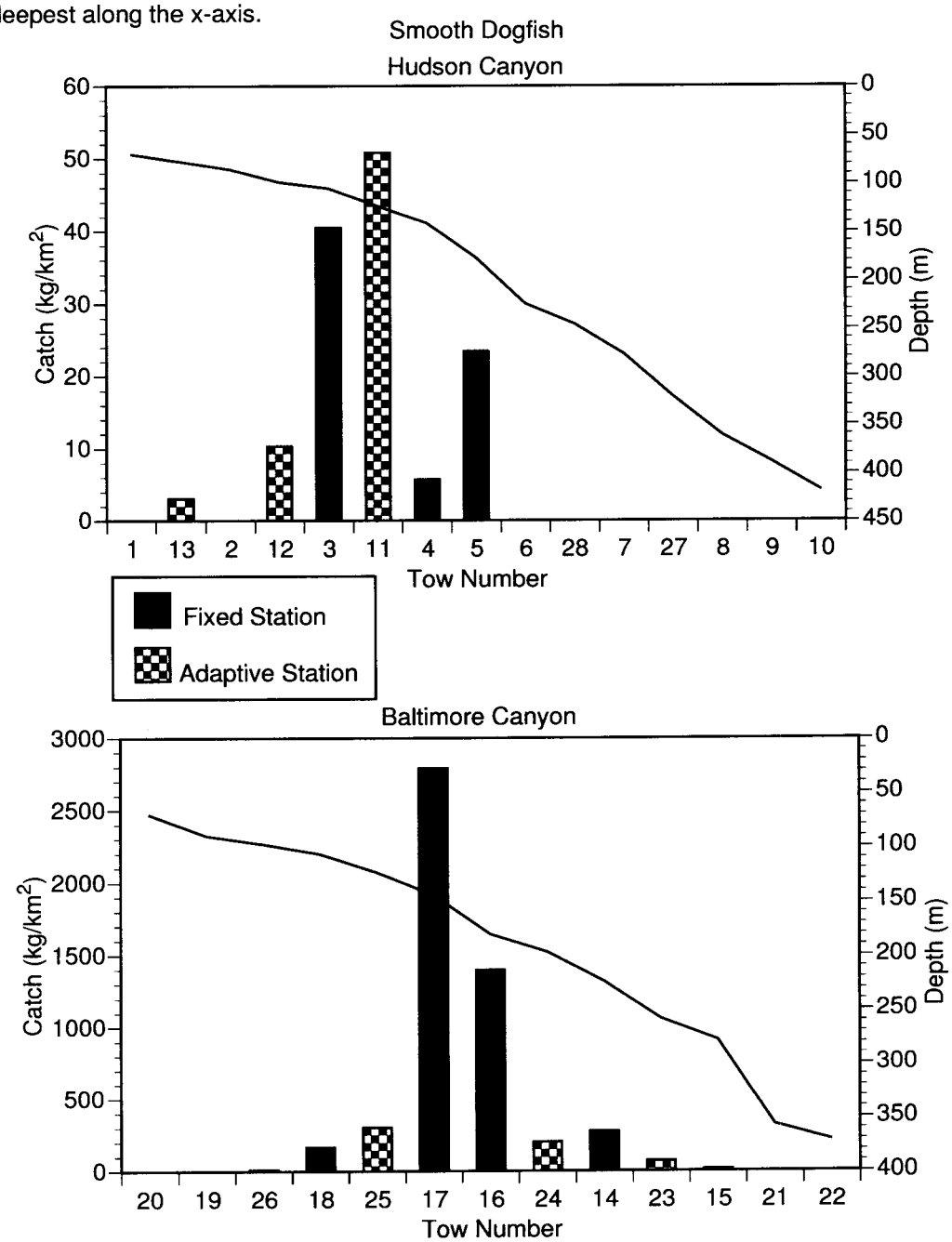


Figure 20b. Projected abundance of smooth dogfish along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

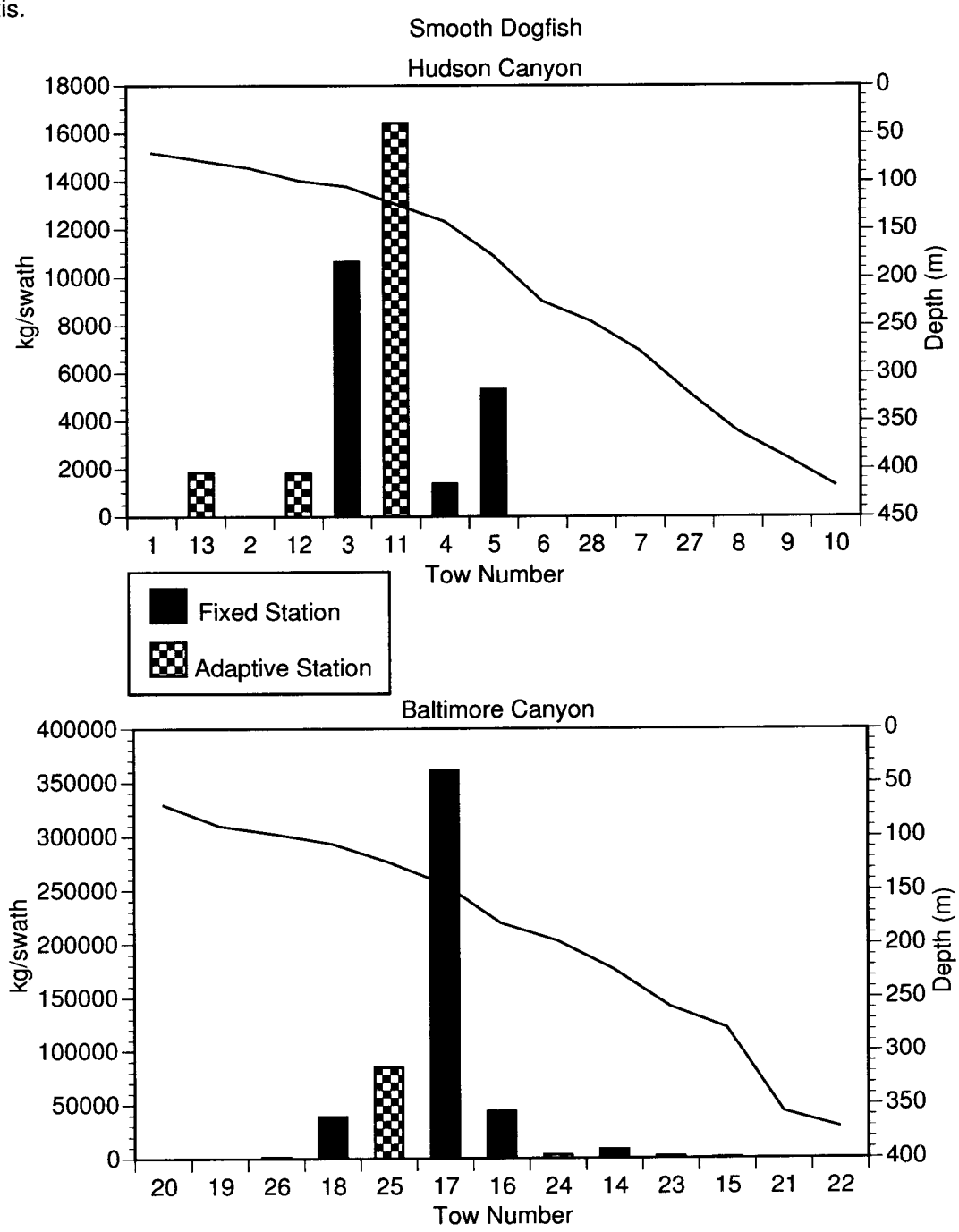


Figure 21a. Catches of spiny dogfish in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

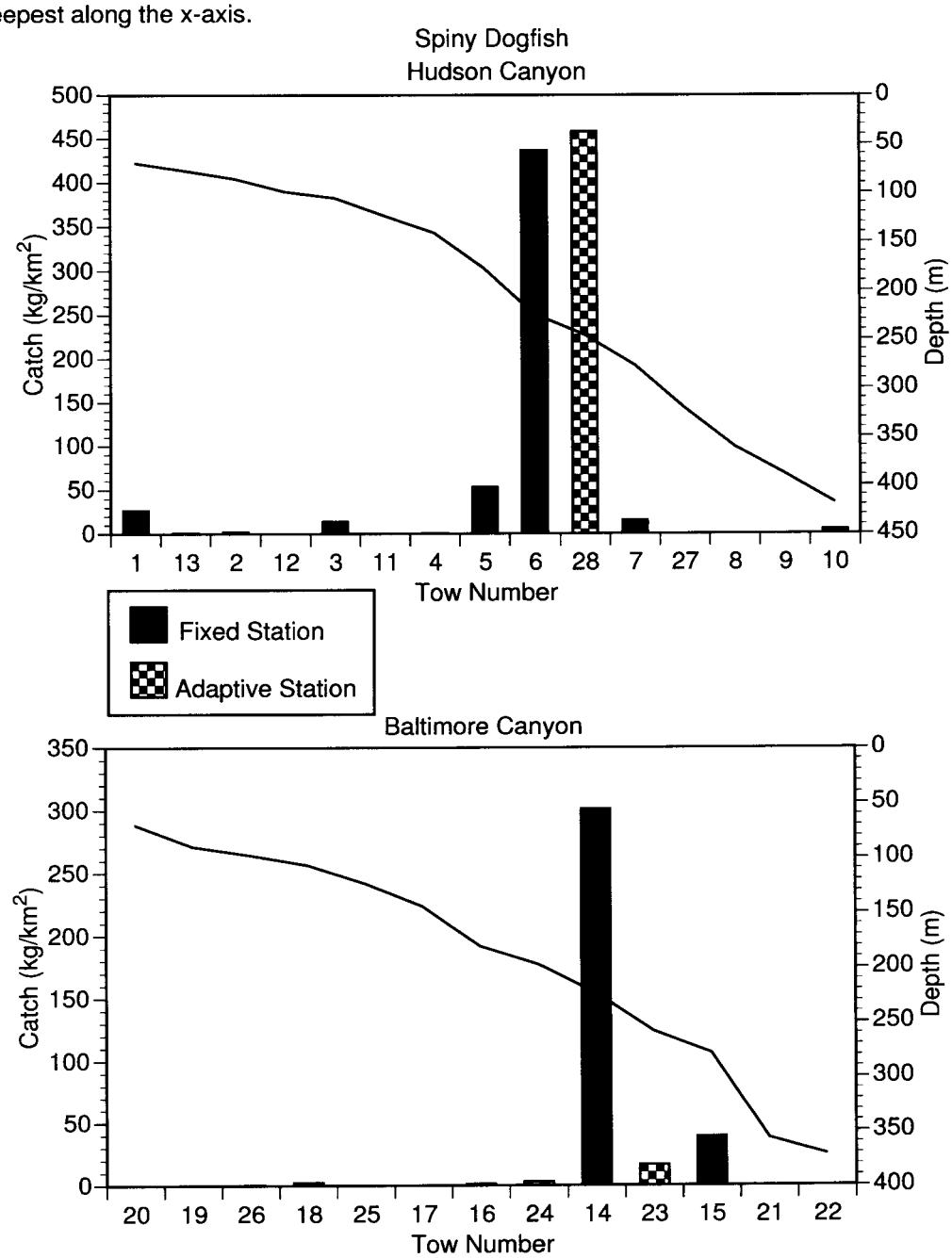


Figure 21b. Projected abundance of spiny dogfish along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

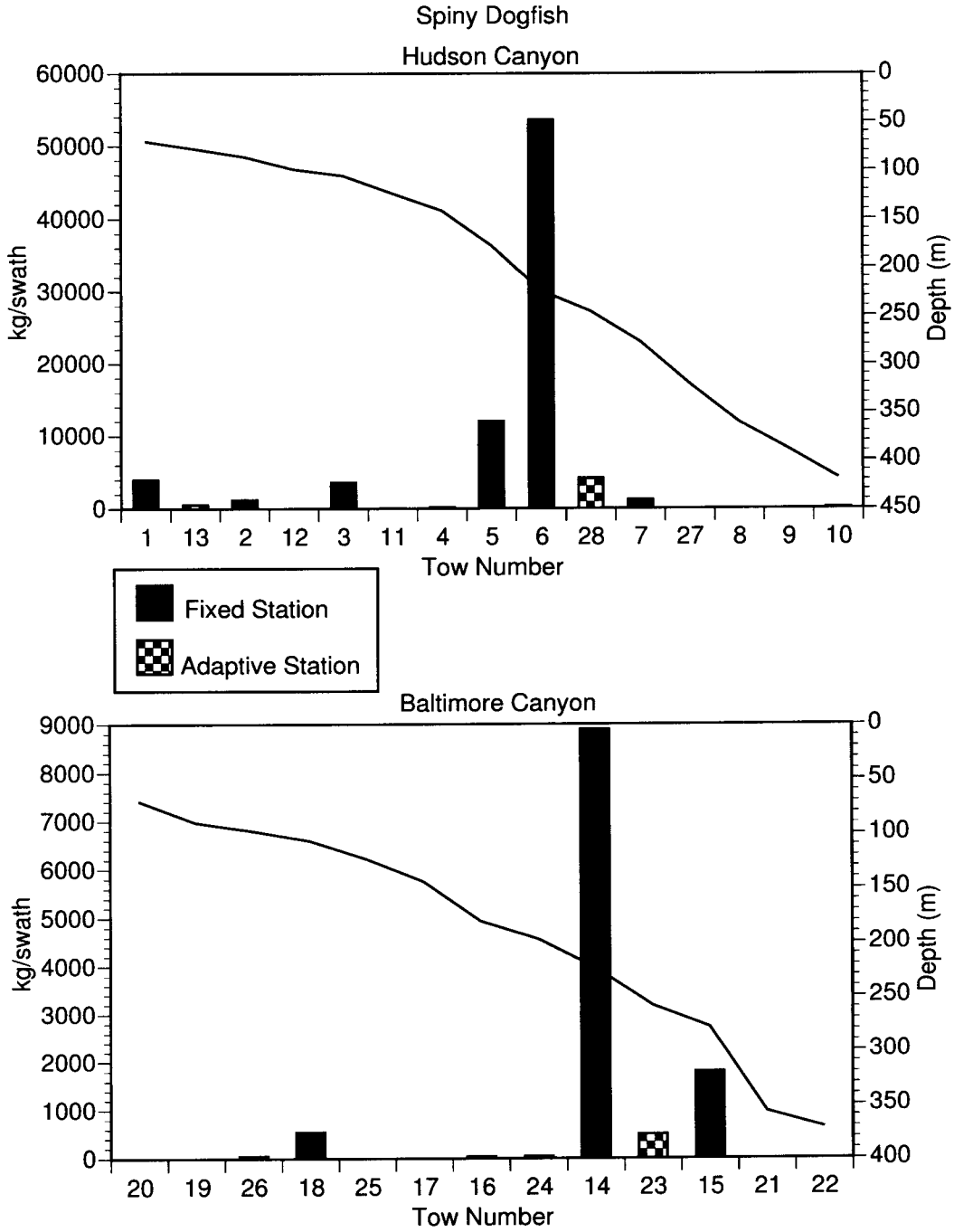


Figure 22a. Catches of spotted hake in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

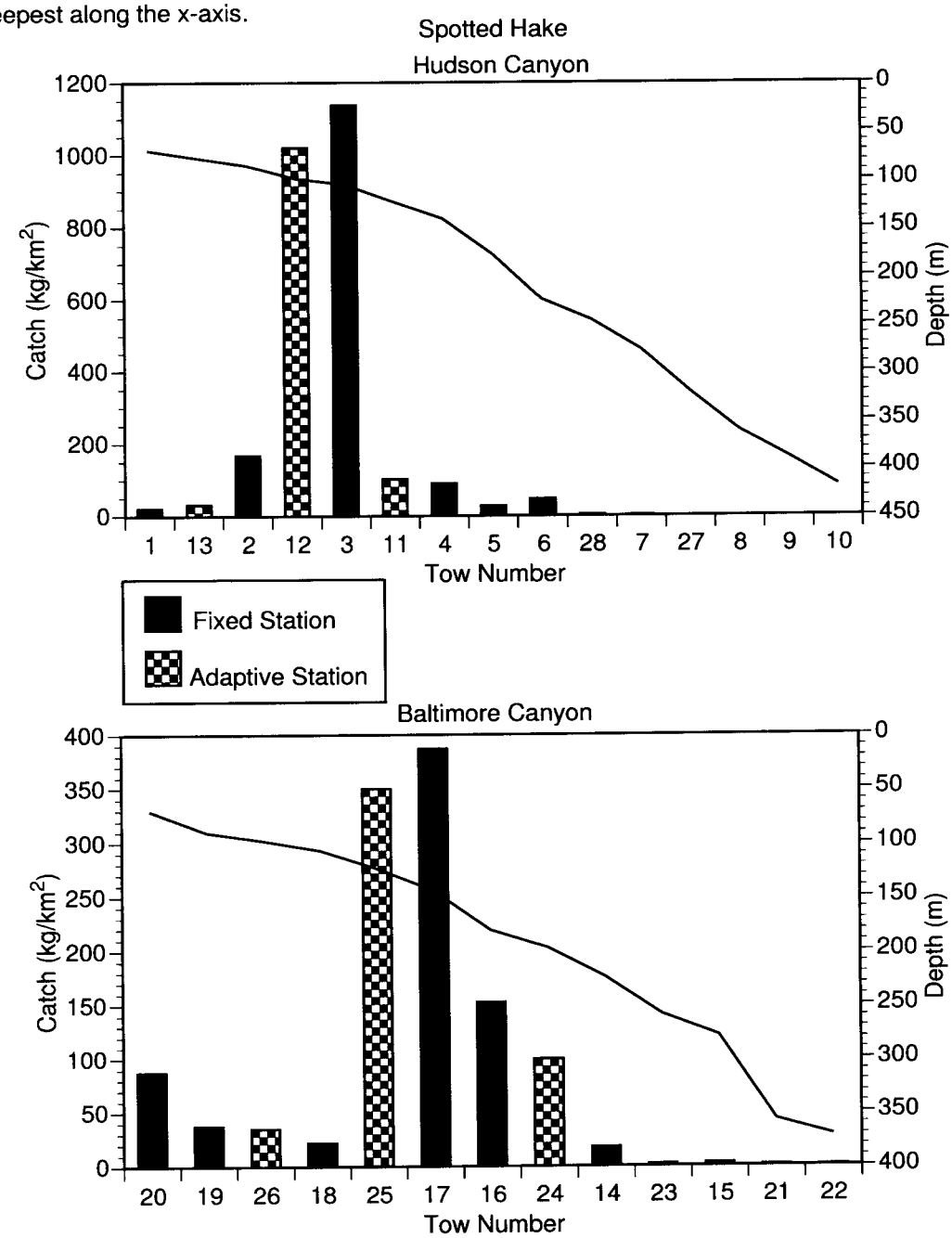


Figure 22b. Projected abundance of spotted hake along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

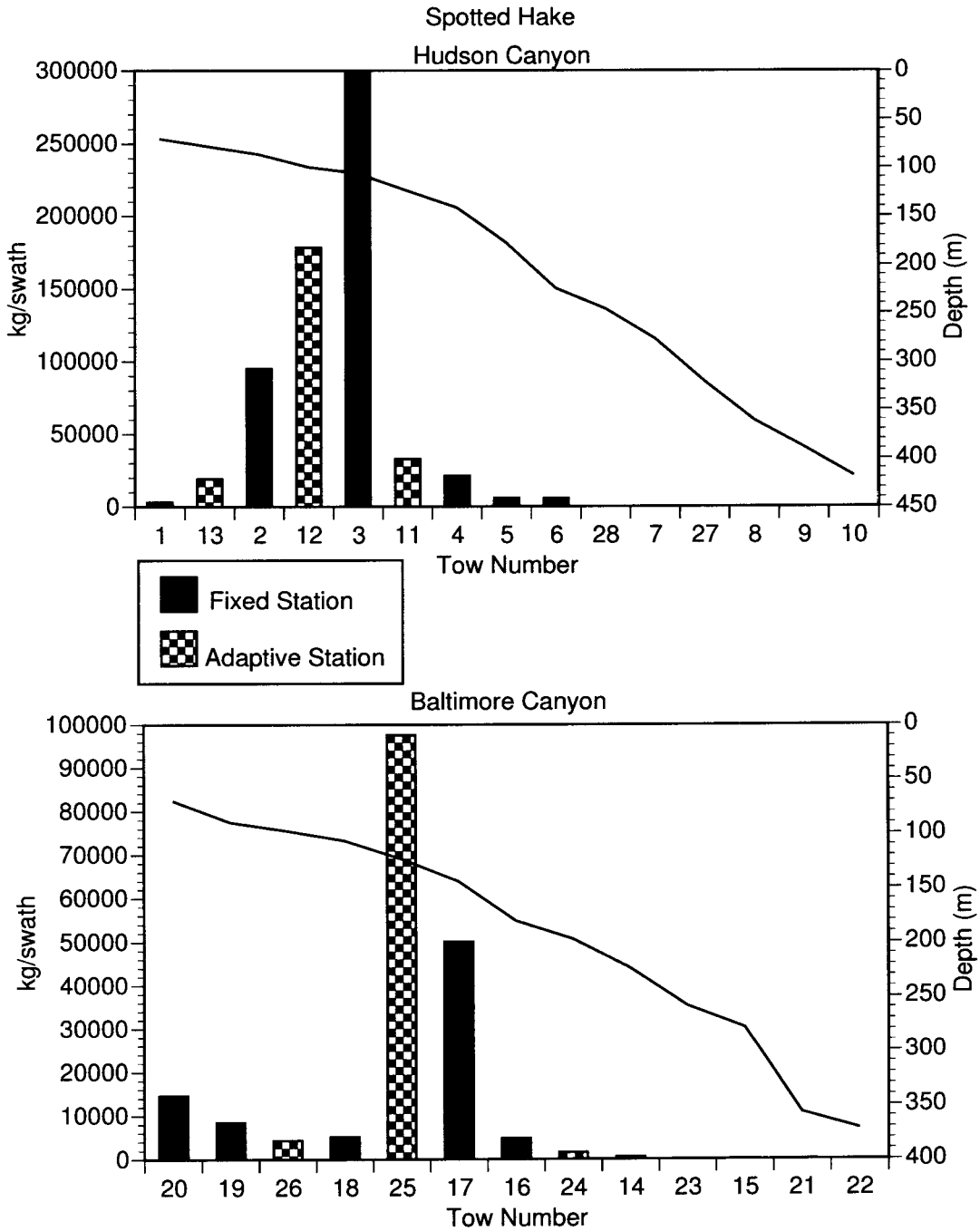


Figure 23a. Catches of summer flounder in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

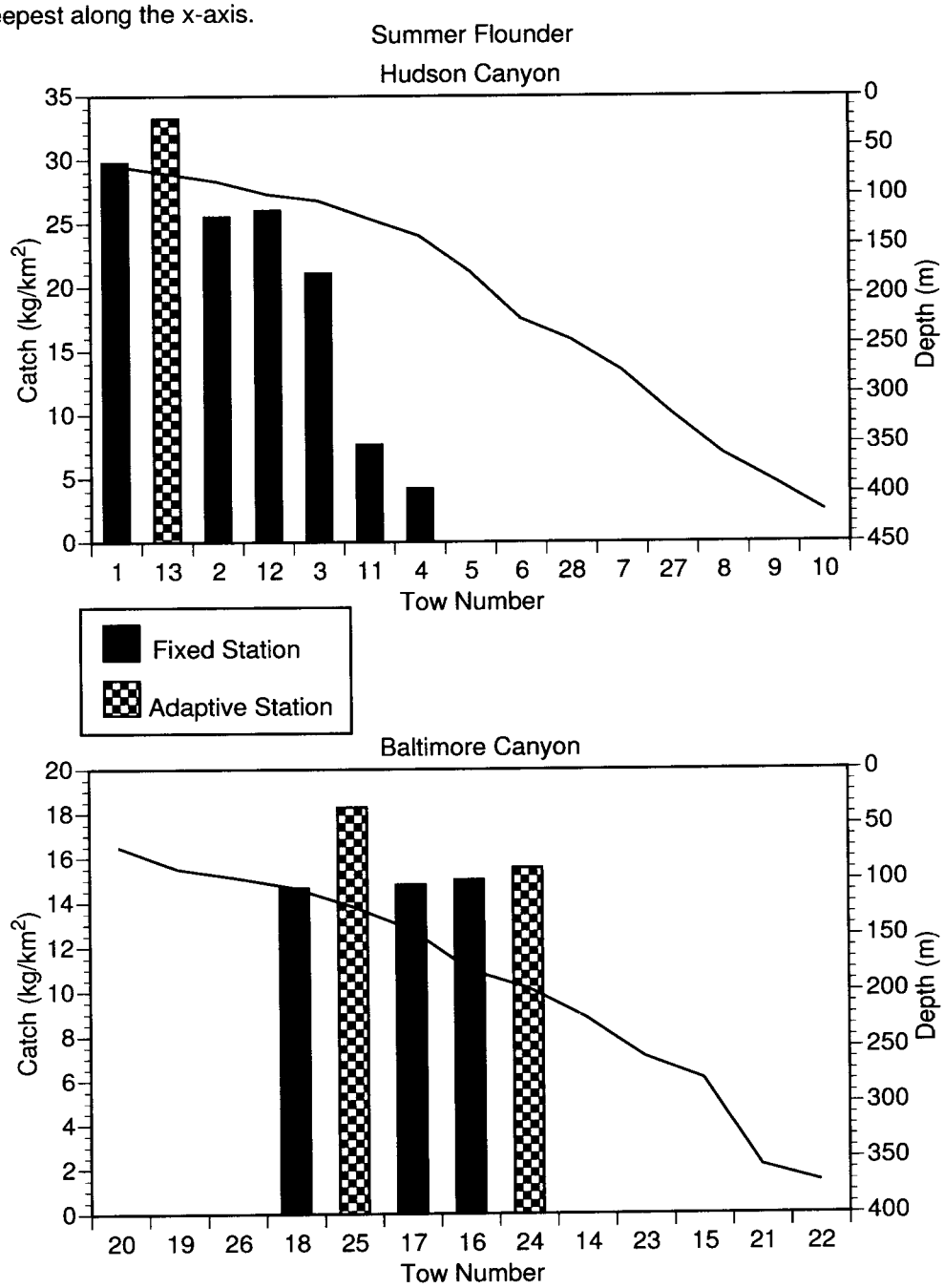


Figure 23b. Projected abundance of summer flounder along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

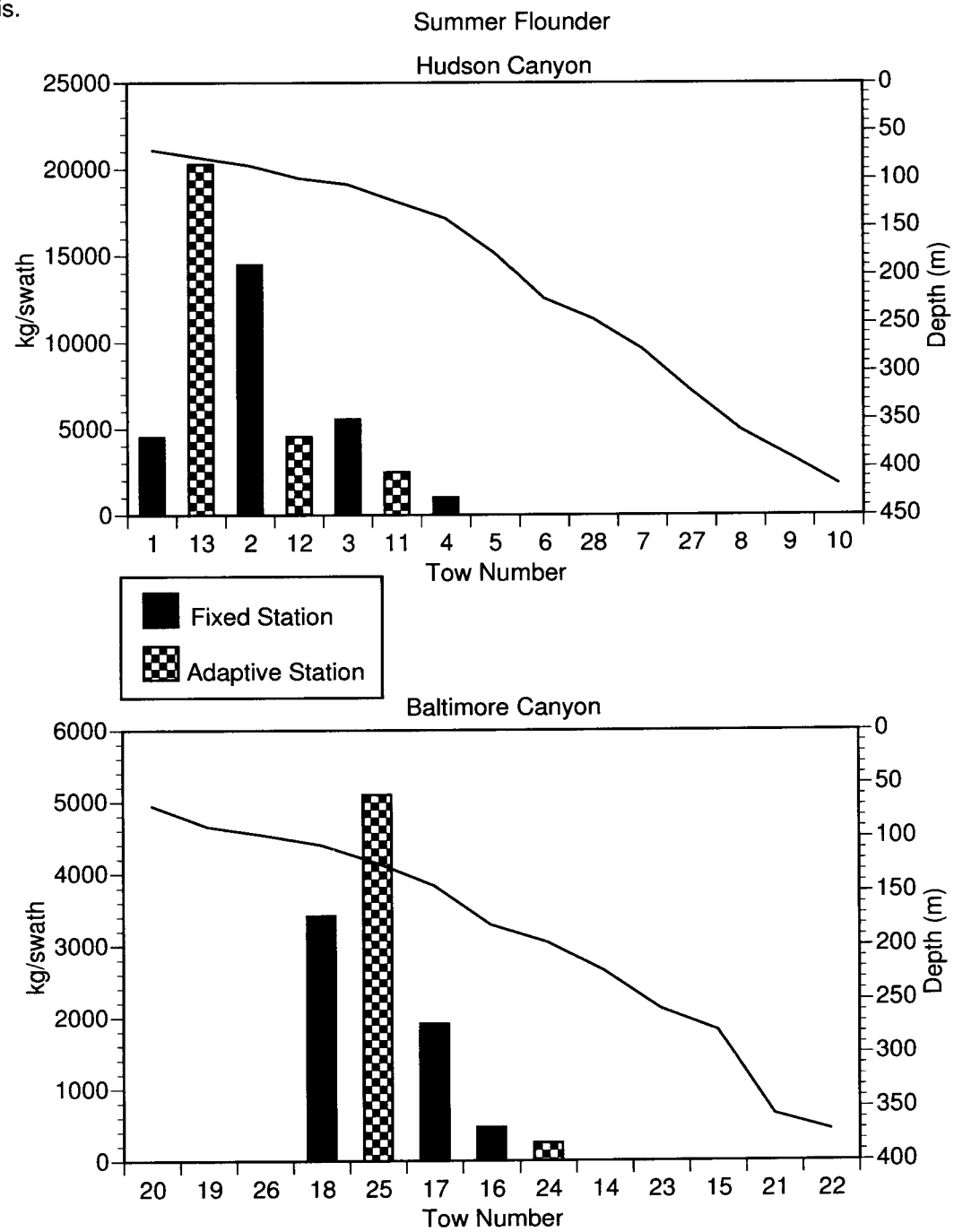


Figure 24a. Catches of tilefish in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

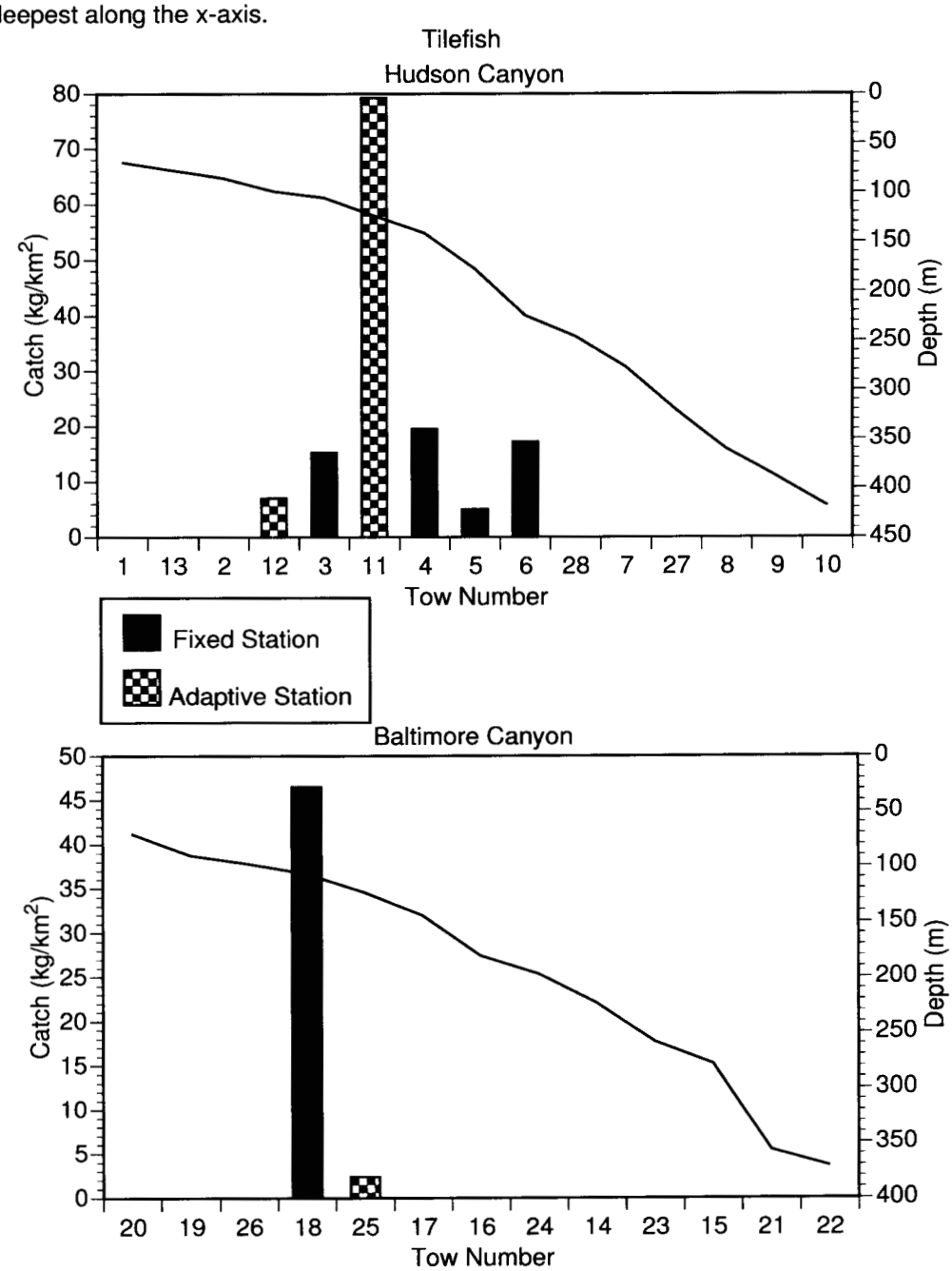


Figure 24b. Projected abundance of tilefish along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

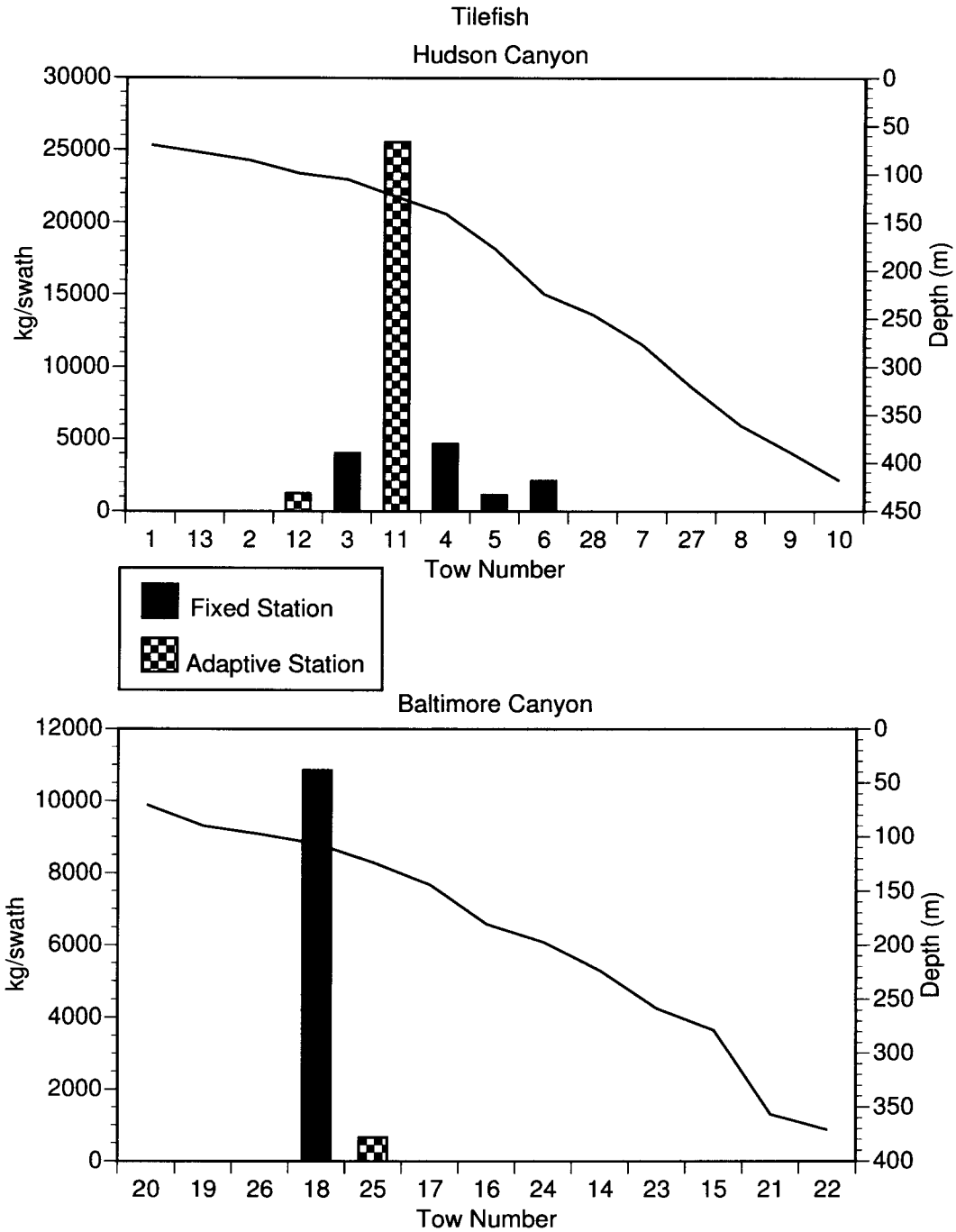


Figure 25a. Catches of witch flounder in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

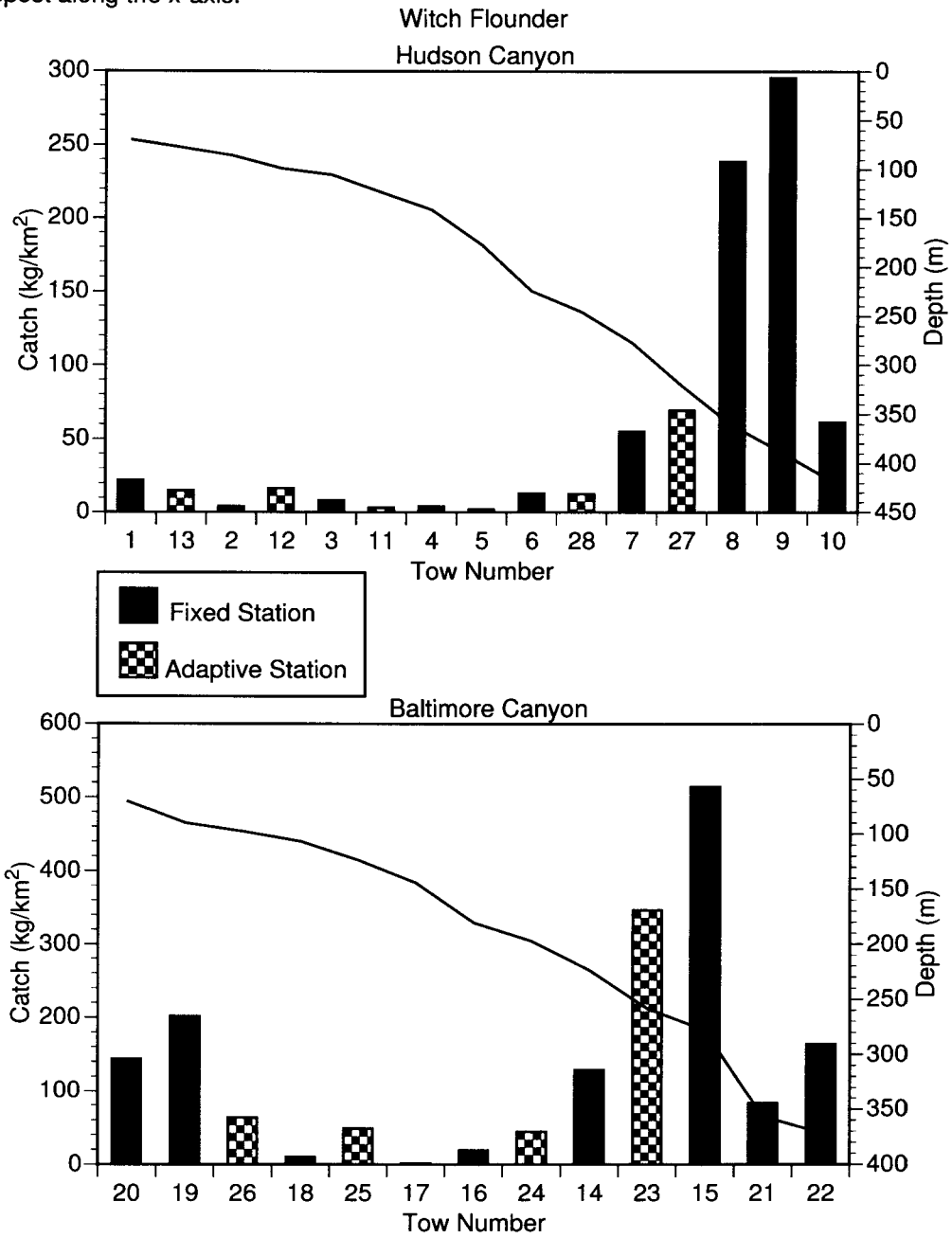


Figure 25b. Projected abundance of witch flounder along the transect with each tow representing the projected abundance for the distance along the transect. Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis.

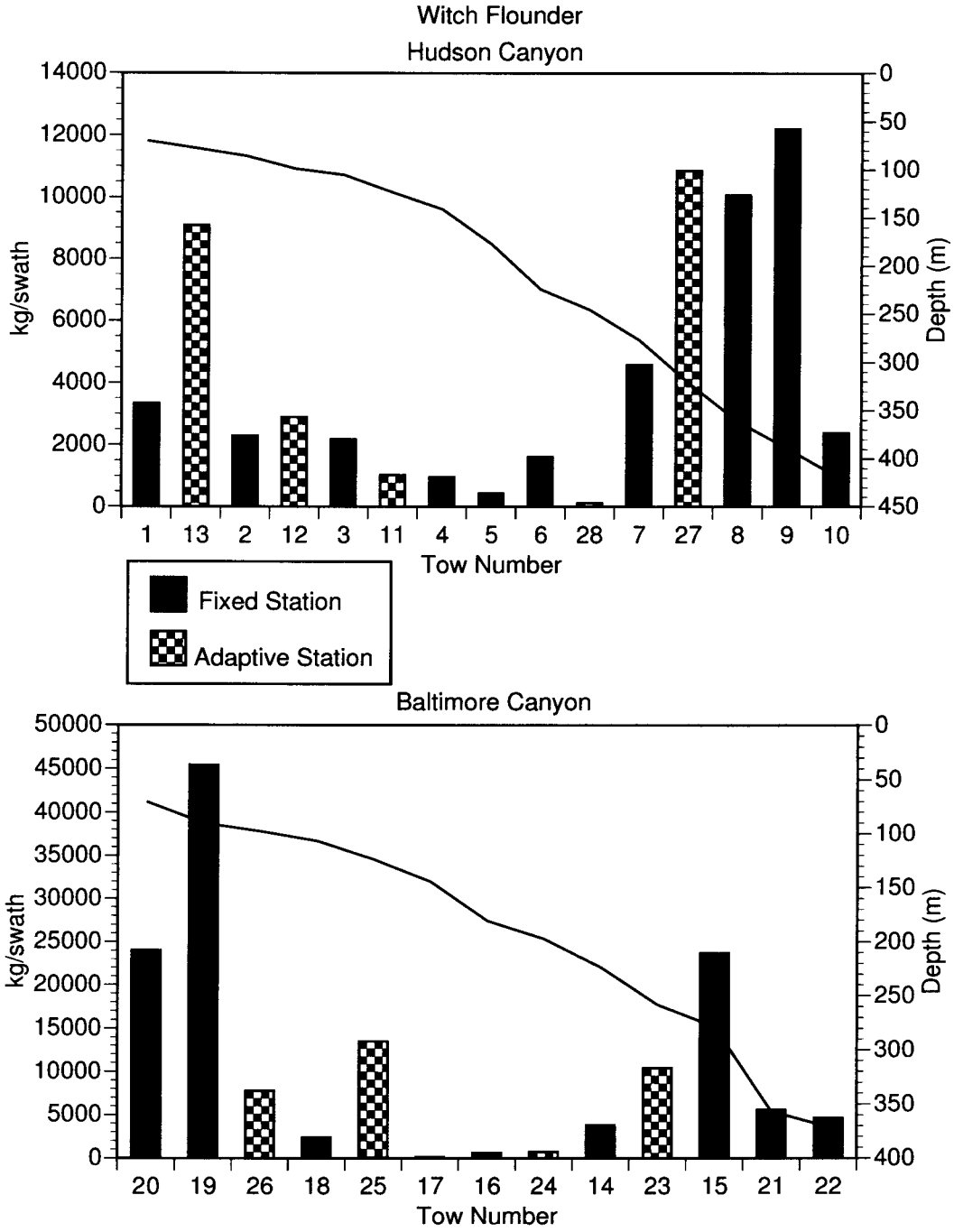


Figure 26a. Cumulative size-frequency distribution of American lobster across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

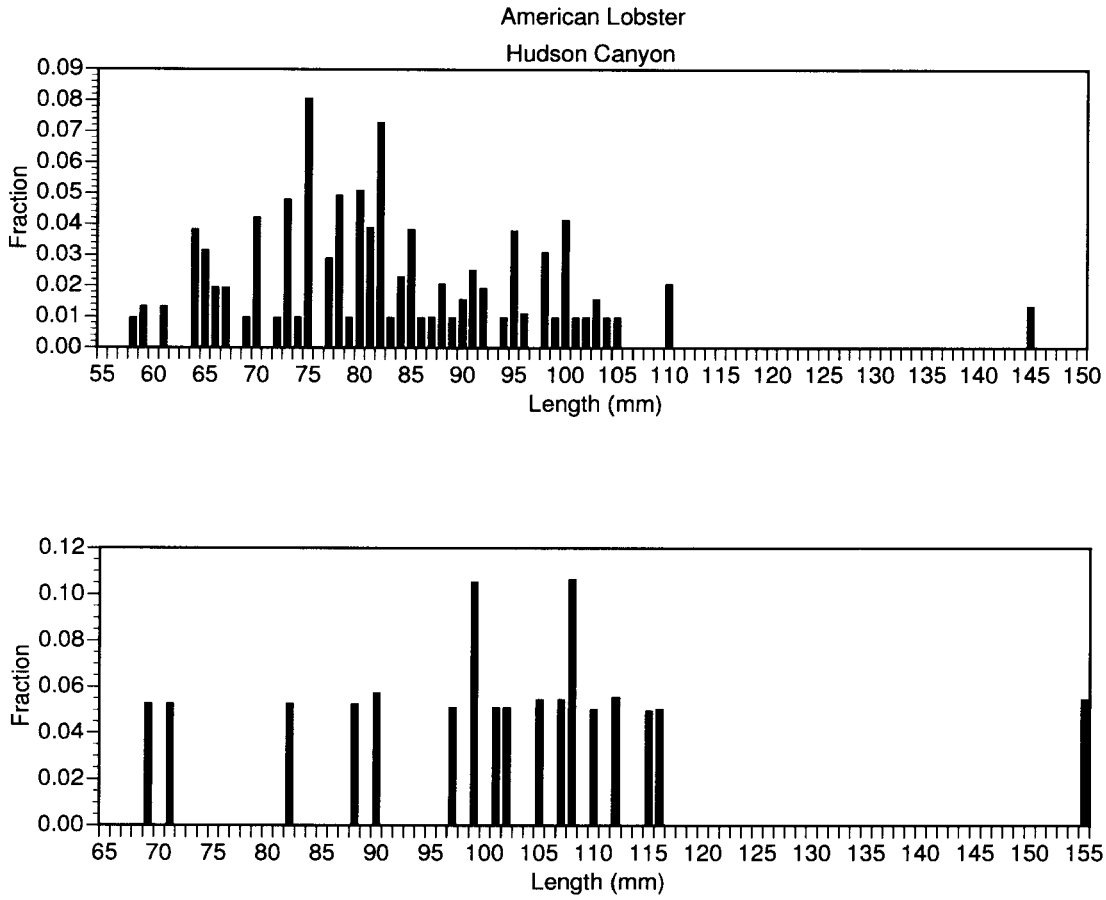


Figure 26b. Cumulative size-frequency distribution of American lobster across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

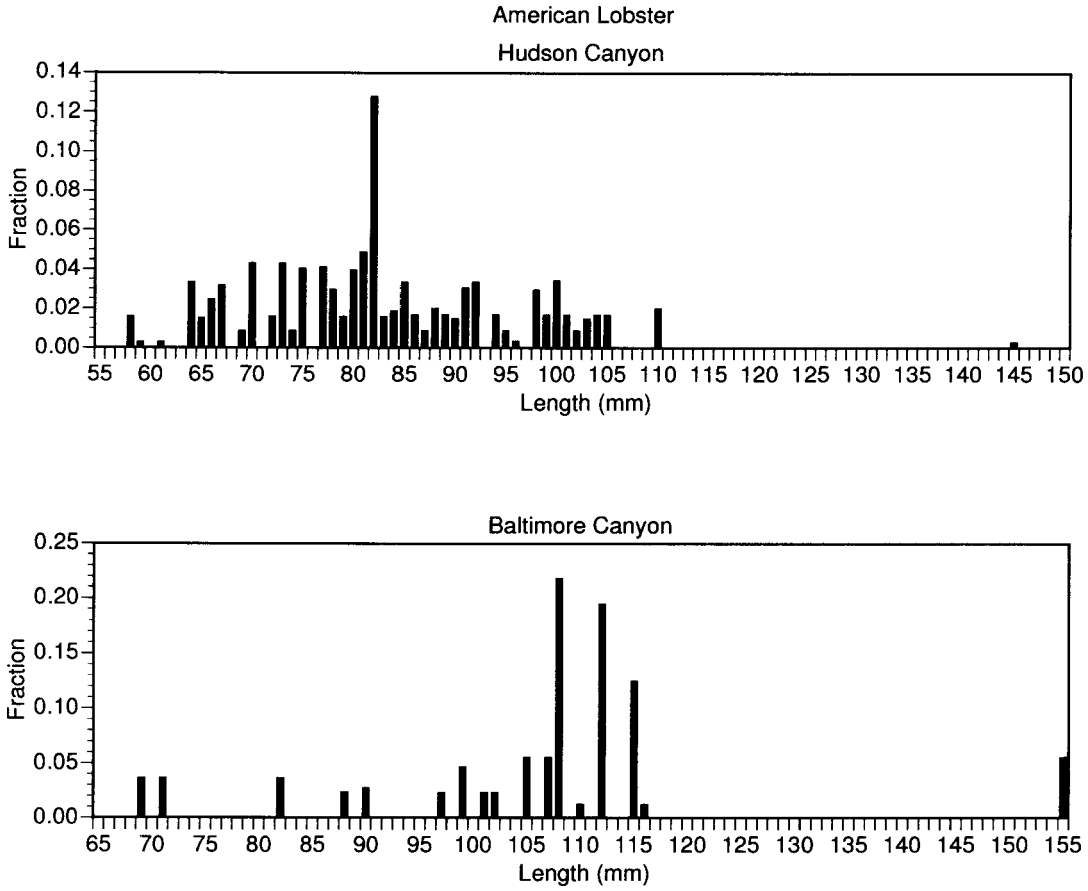


Figure 27a. Cumulative size-frequency distribution of black sea bass across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

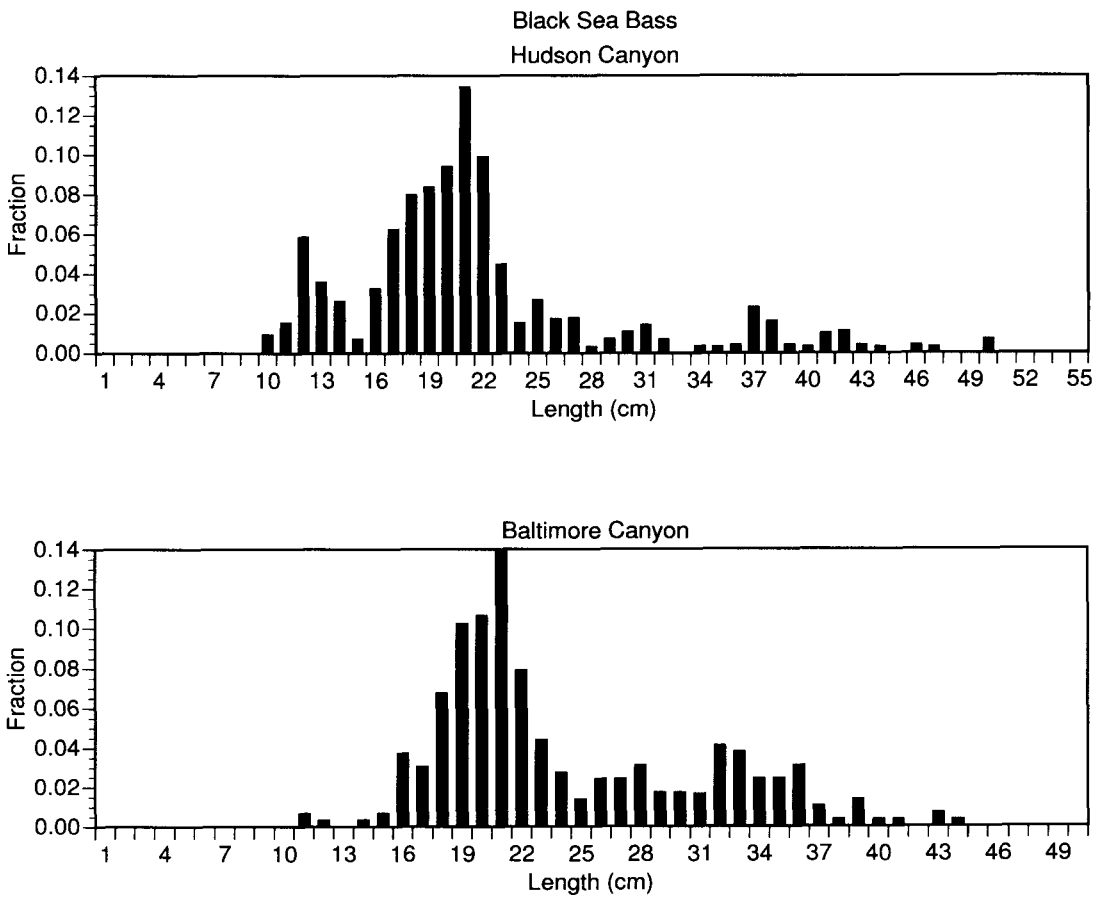


Figure 27b. Cumulative size-frequency distribution of black sea bass across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

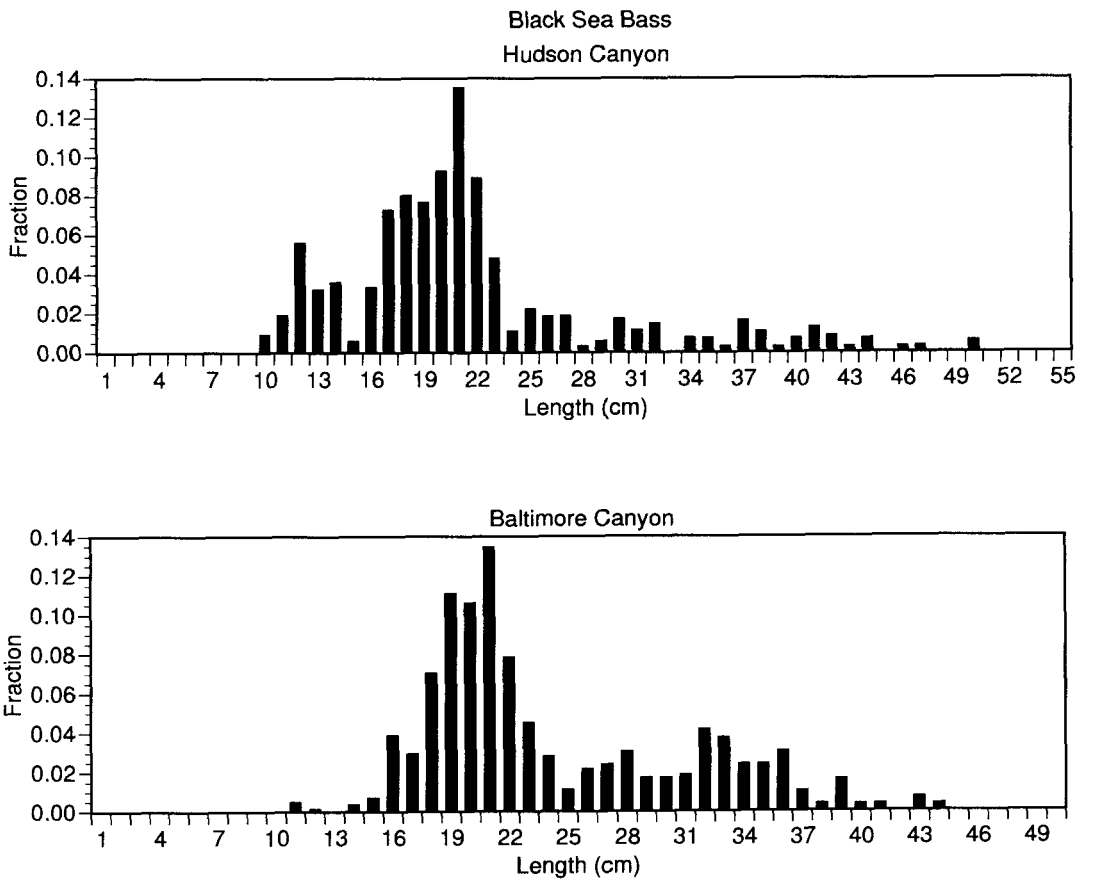


Figure 28a. Cumulative size-frequency distribution of *Illex* squid across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

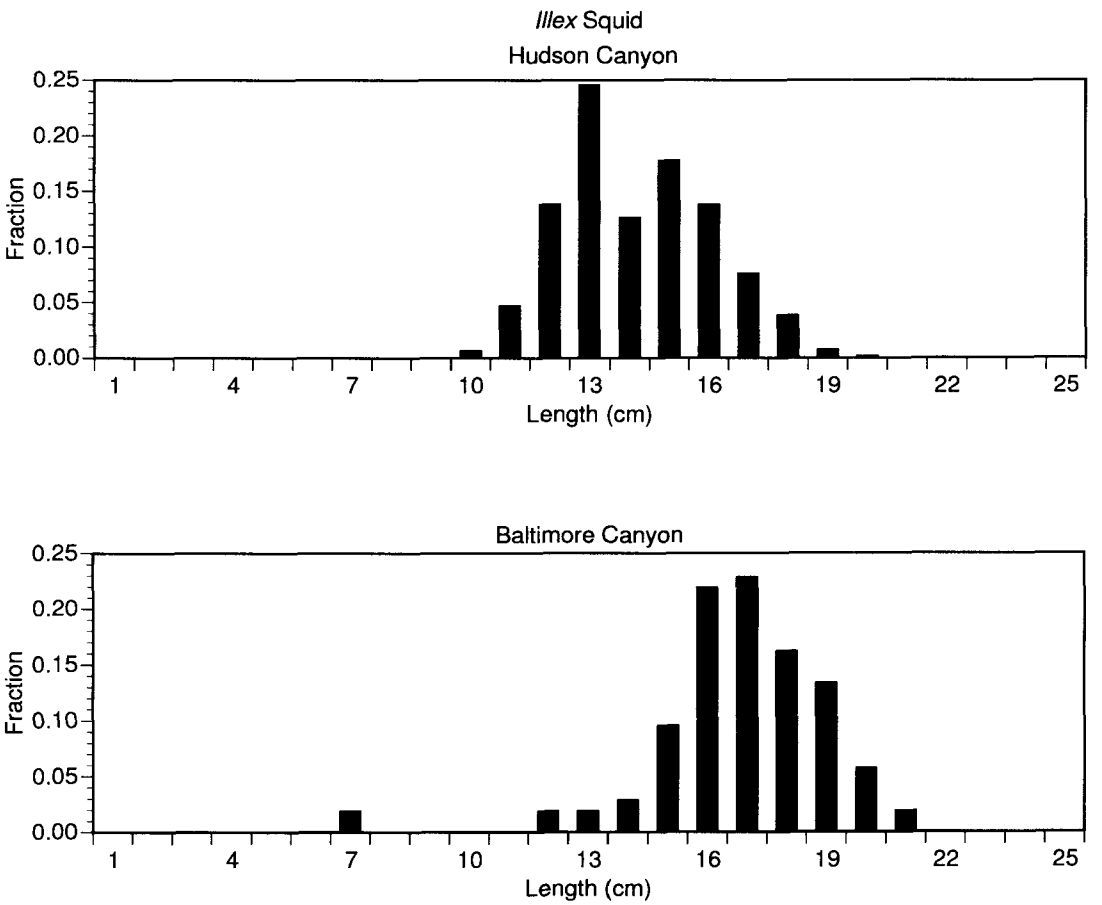


Figure 28b. Cumulative size-frequency distribution of *Illex* squid across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

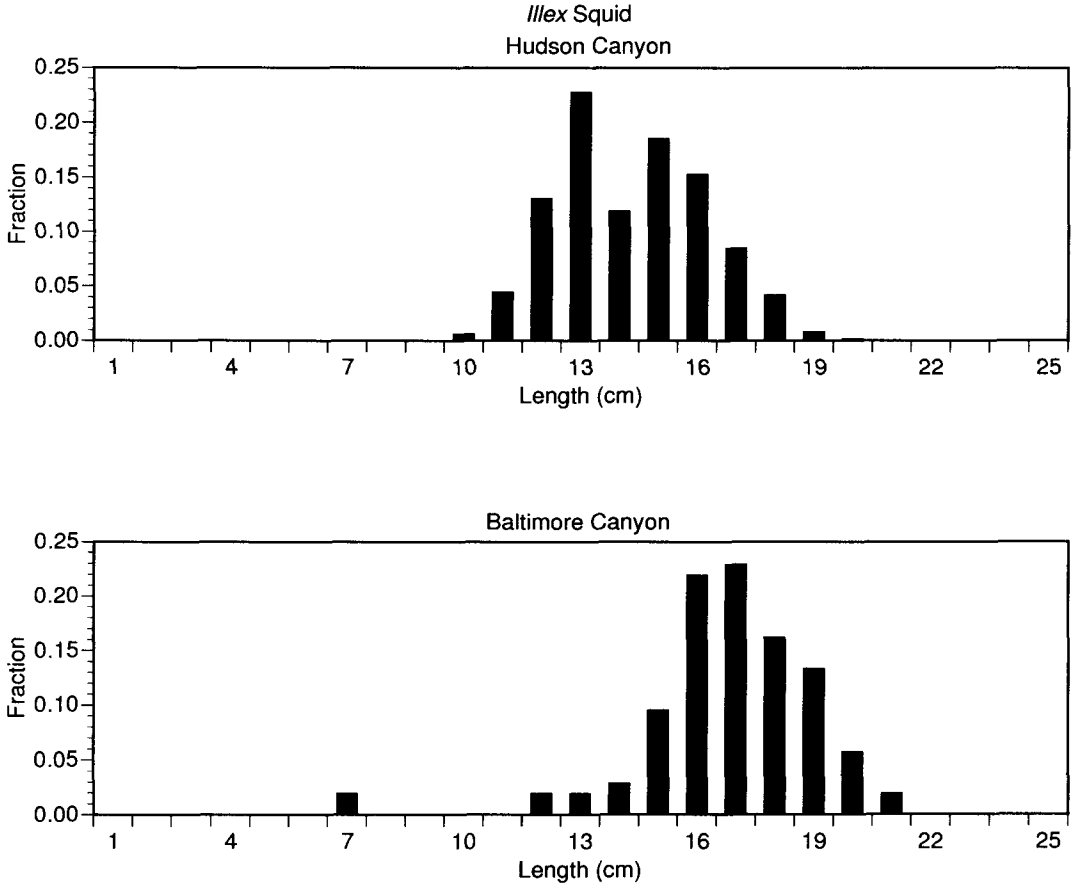


Figure 29a. Cumulative size-frequency distribution of *Loligo* squid across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

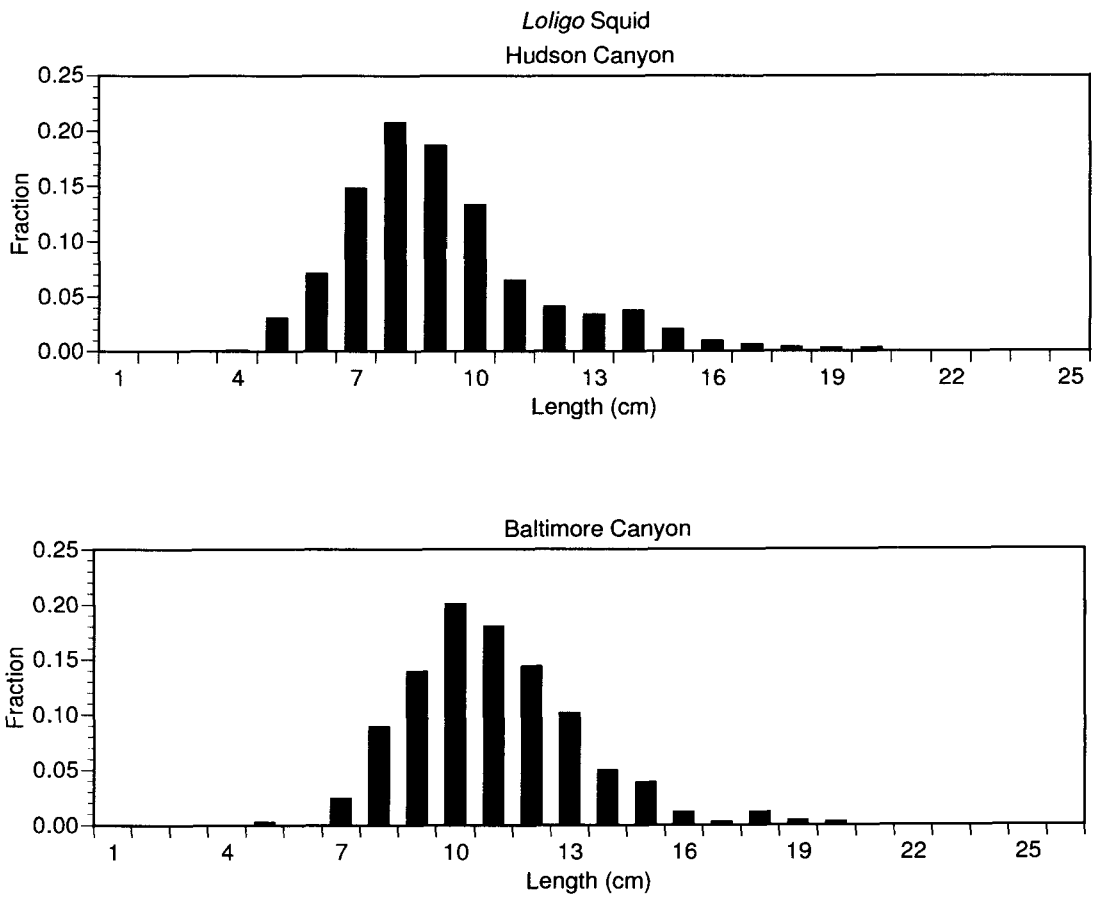


Figure 29b. Cumulative size-frequency distribution of *Loligo* squid across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

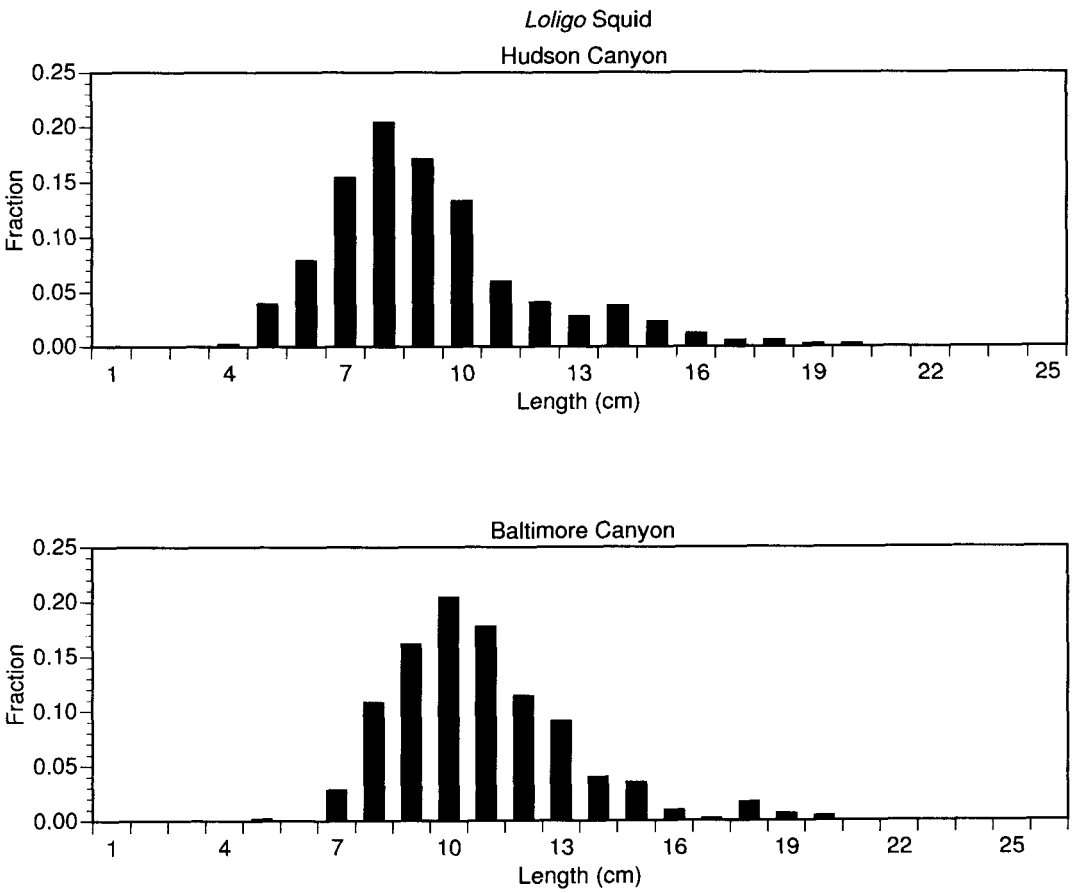


Figure 30a. Cumulative size-frequency distribution of monkfish across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

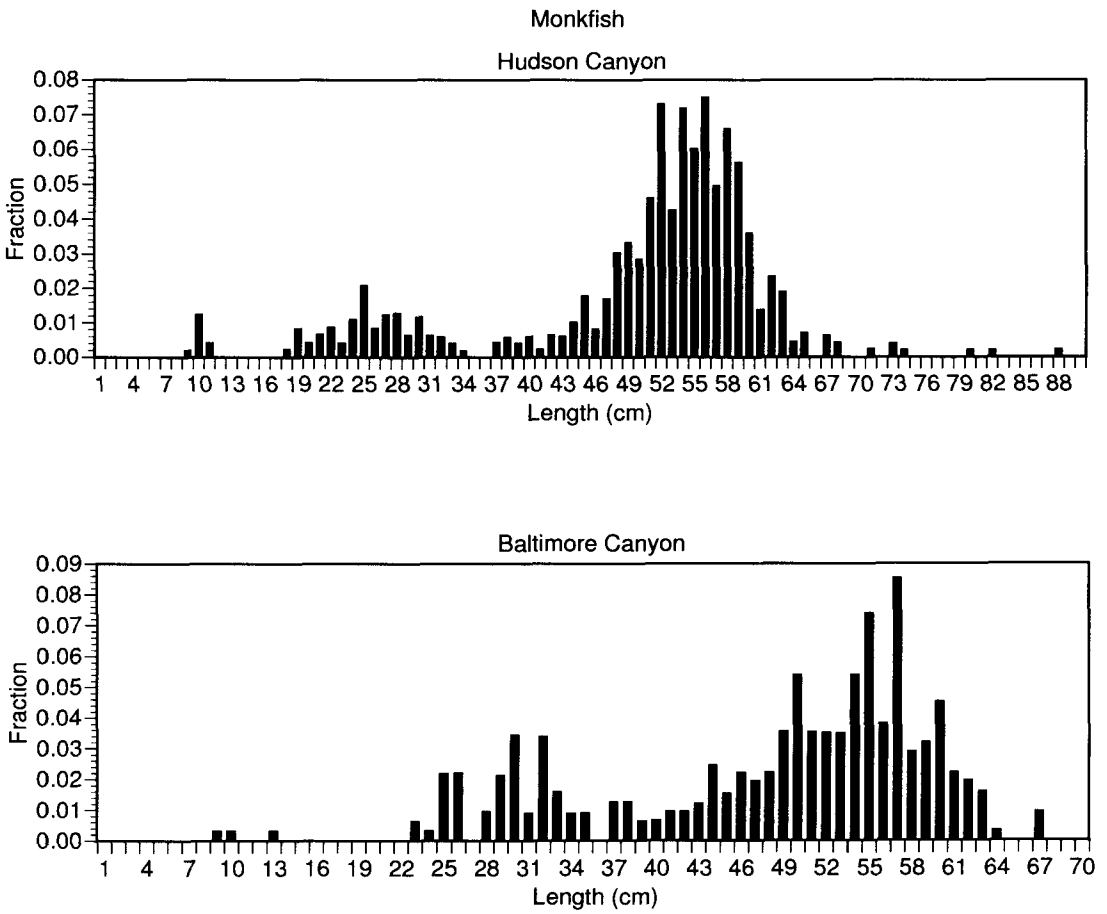
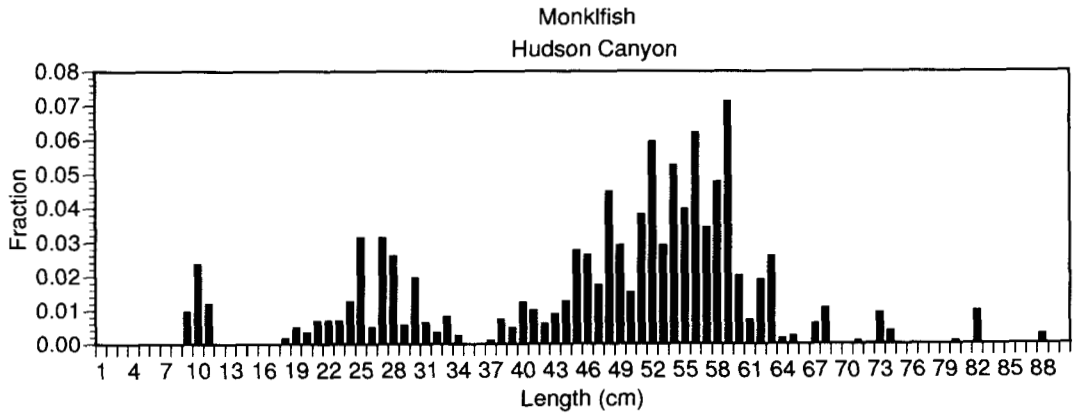


Figure 30b. Cumulative size-frequency distribution of monkfish across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.



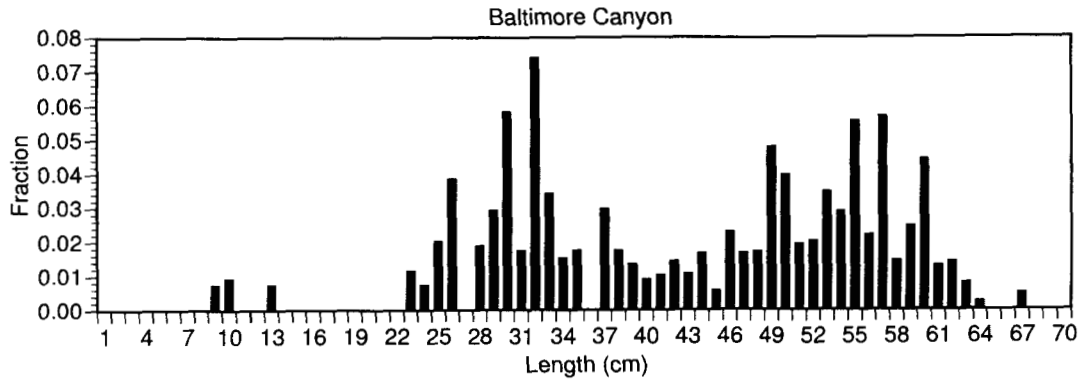
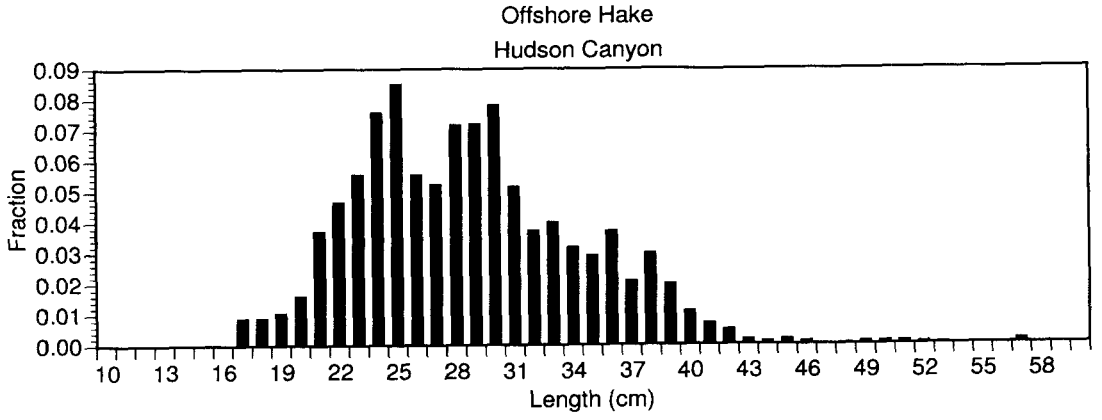


Figure 31a. Cumulative size-frequency distribution of offshore hake across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.



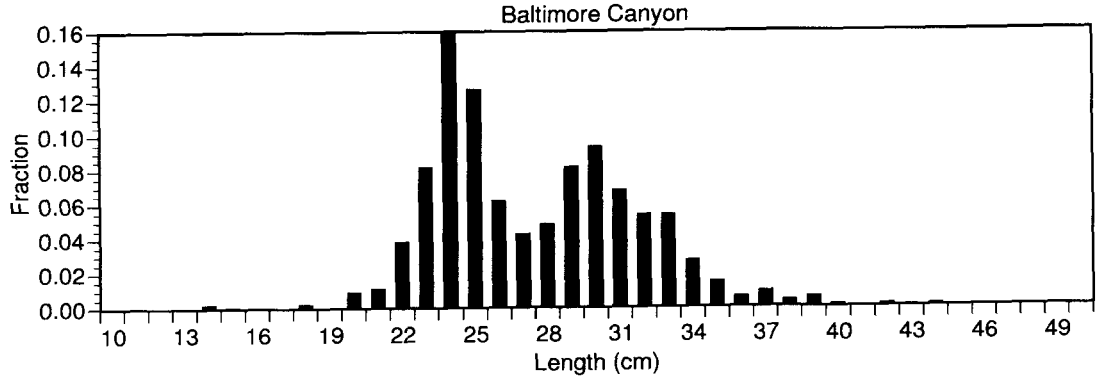


Figure 31b. Cumulative size-frequency distribution of offshore hake across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

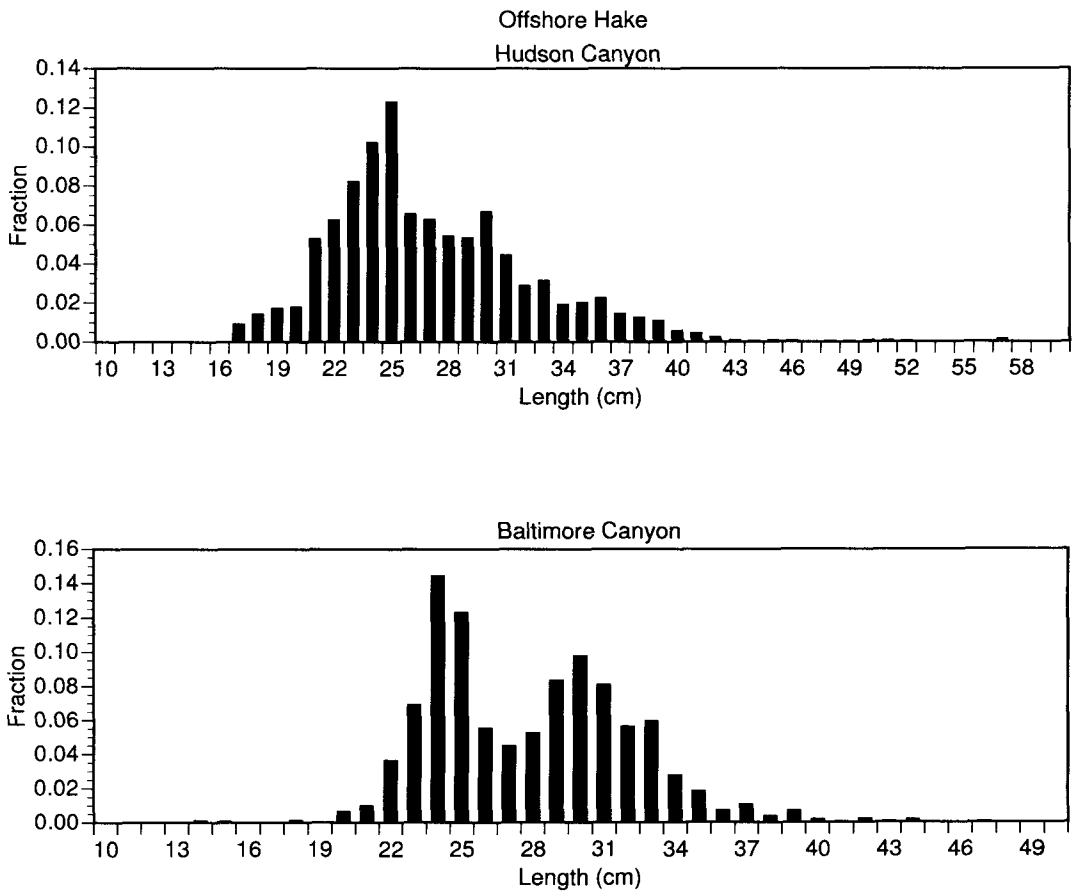


Figure 32a. Cumulative size-frequency distribution of scup across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

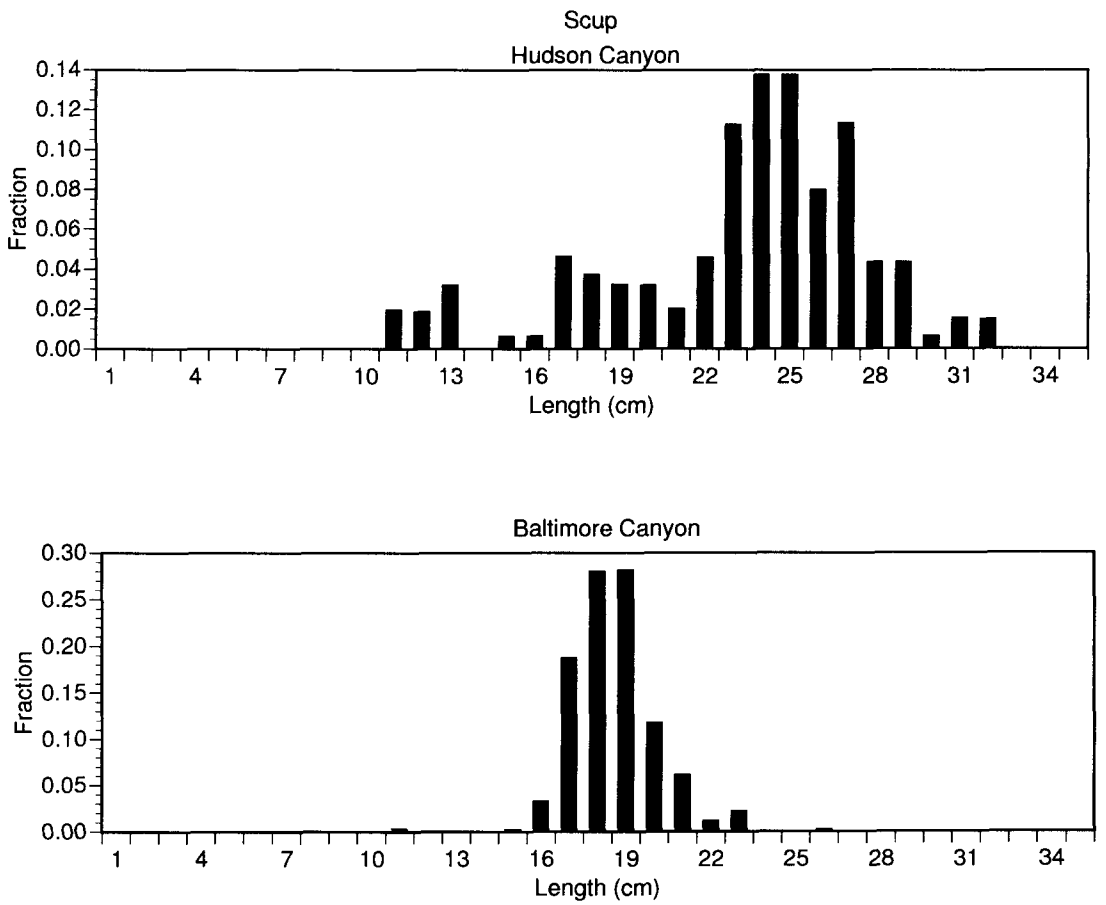


Figure 32b. Cumulative size-frequency distribution of scup across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

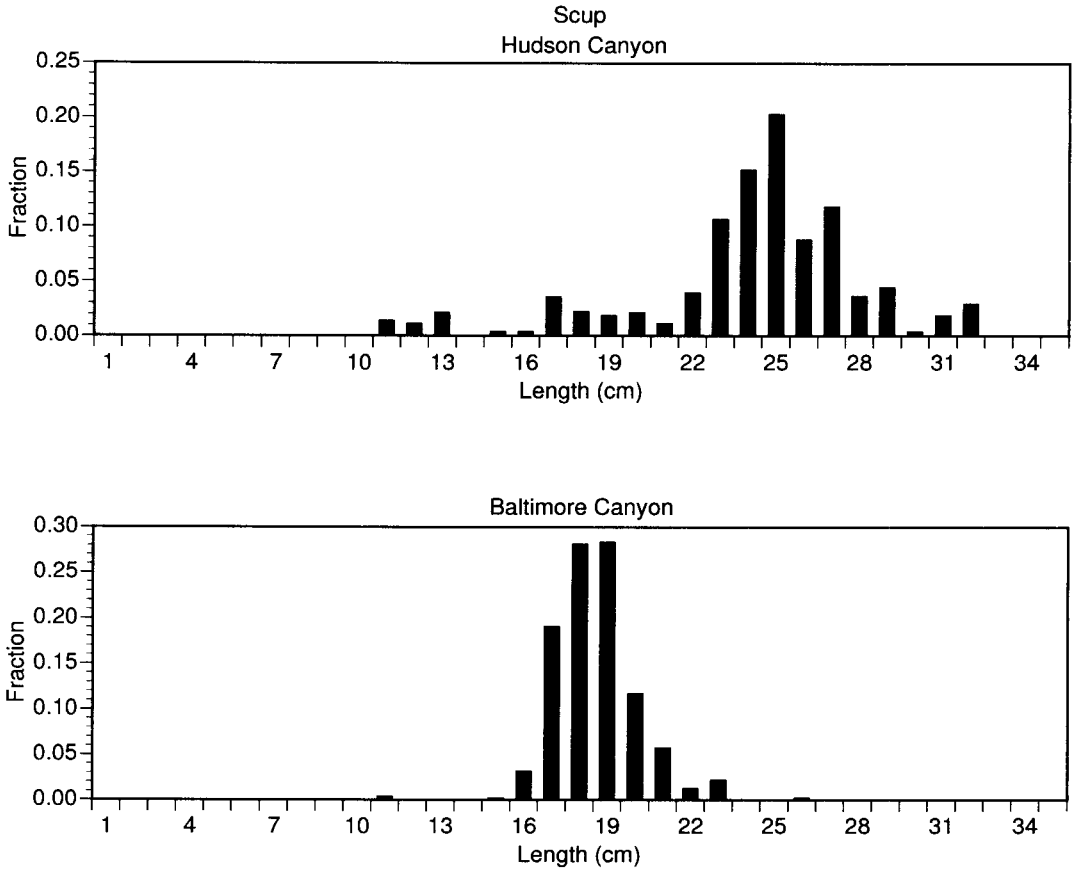


Figure 33a. Cumulative size-frequency distribution of silver hake across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

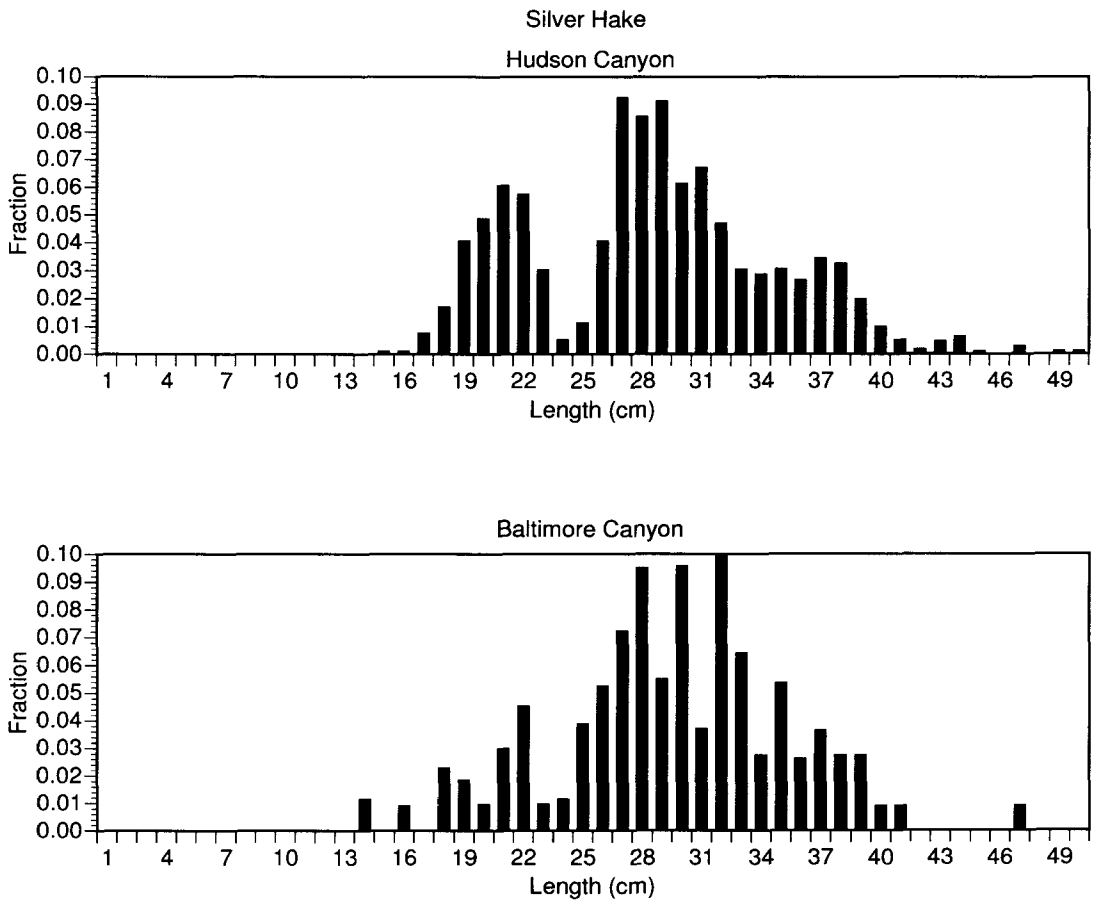


Figure 33b. Cumulative size-frequency distribution of silver hake across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

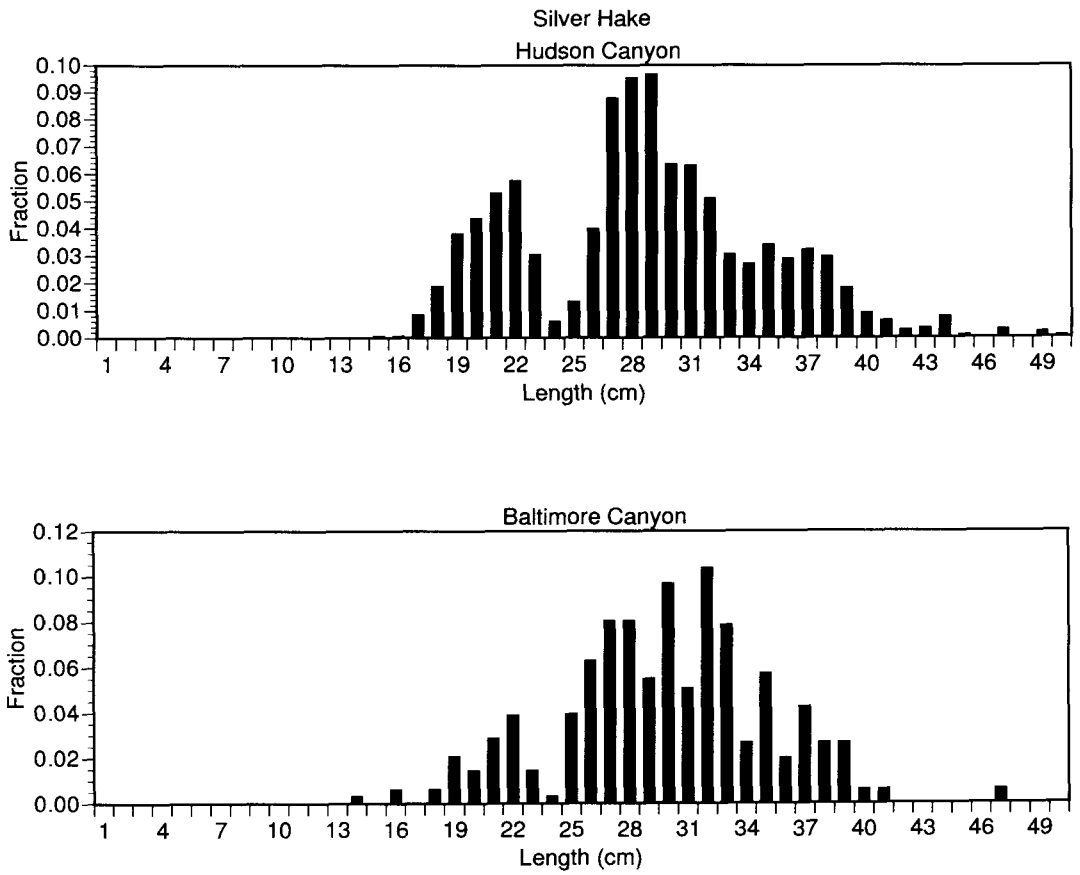
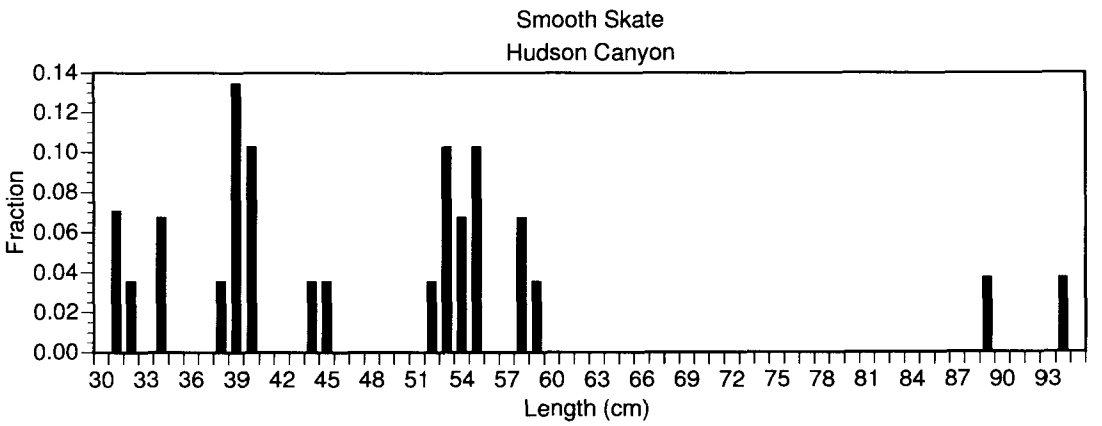


Figure 34a. Cumulative size-frequency distribution of smooth skate across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.



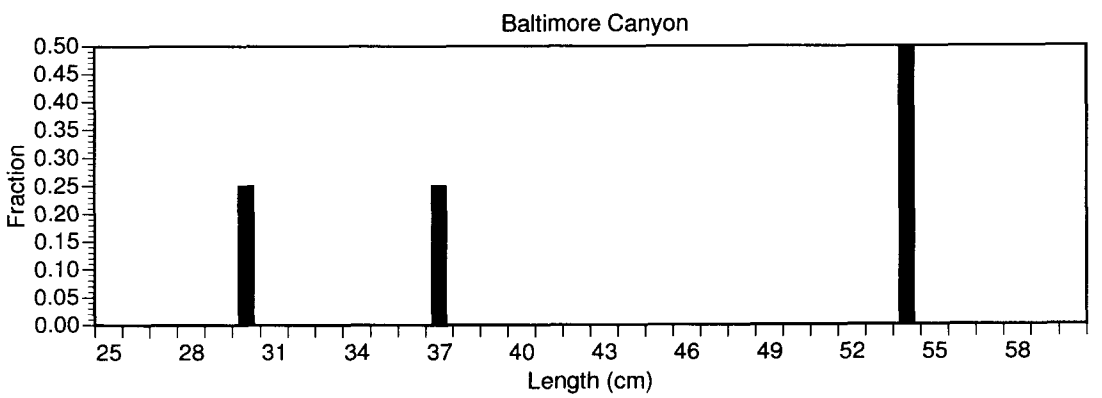


Figure 34b. Cumulative size-frequency distribution of smooth skate across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

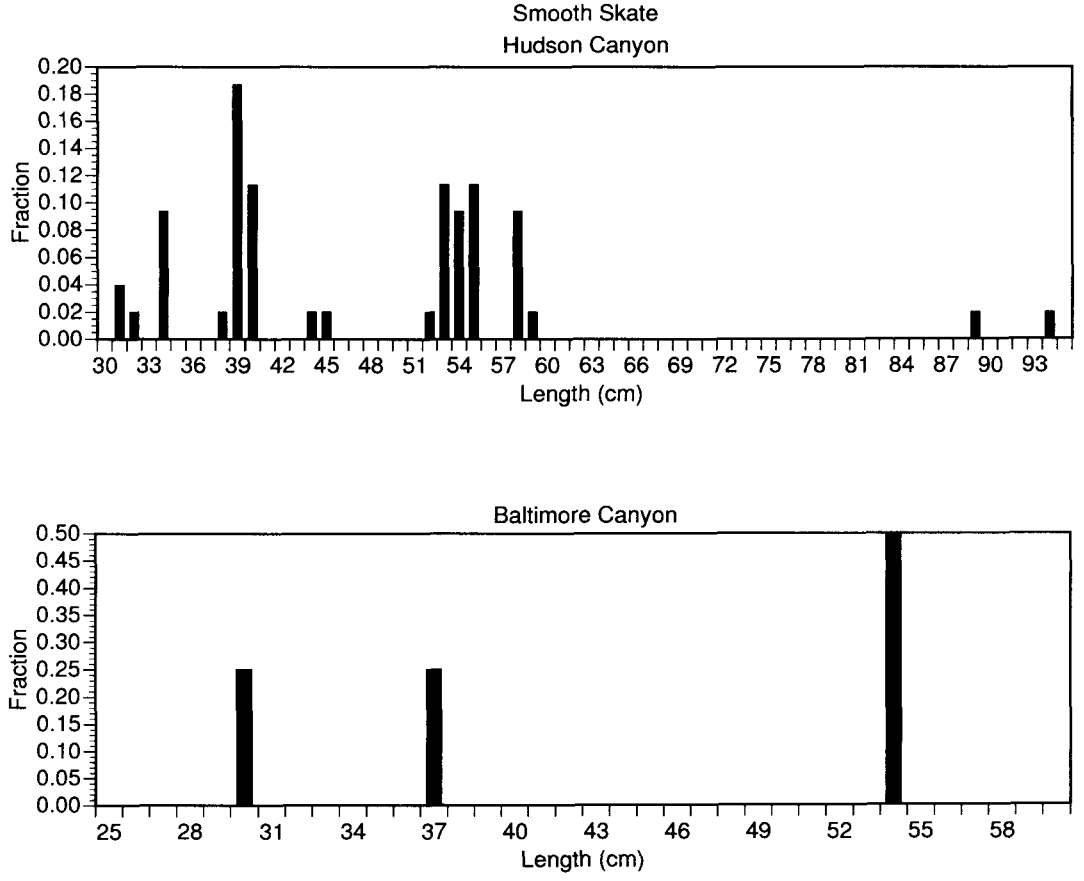
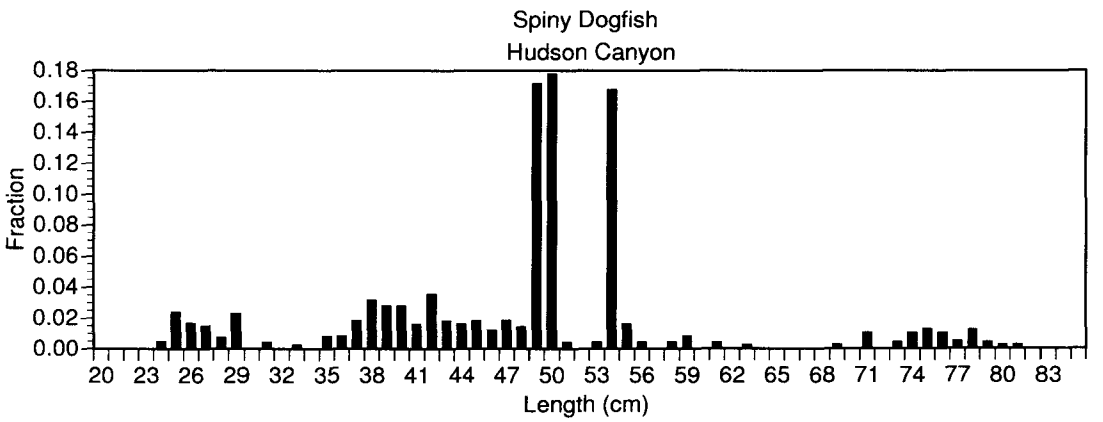


Figure 35a. Cumulative size-frequency distribution of spiny dogfish across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.



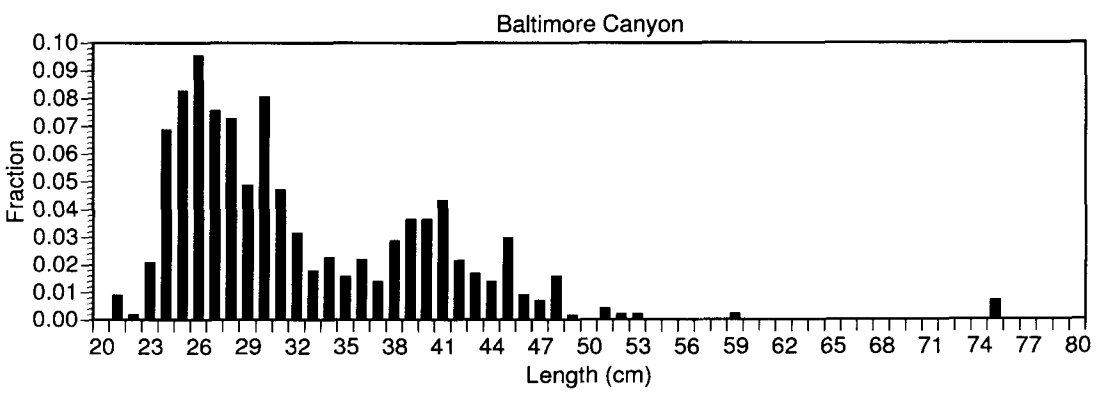


Figure 35b. Cumulative size-frequency distribution of spiny dogfish across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

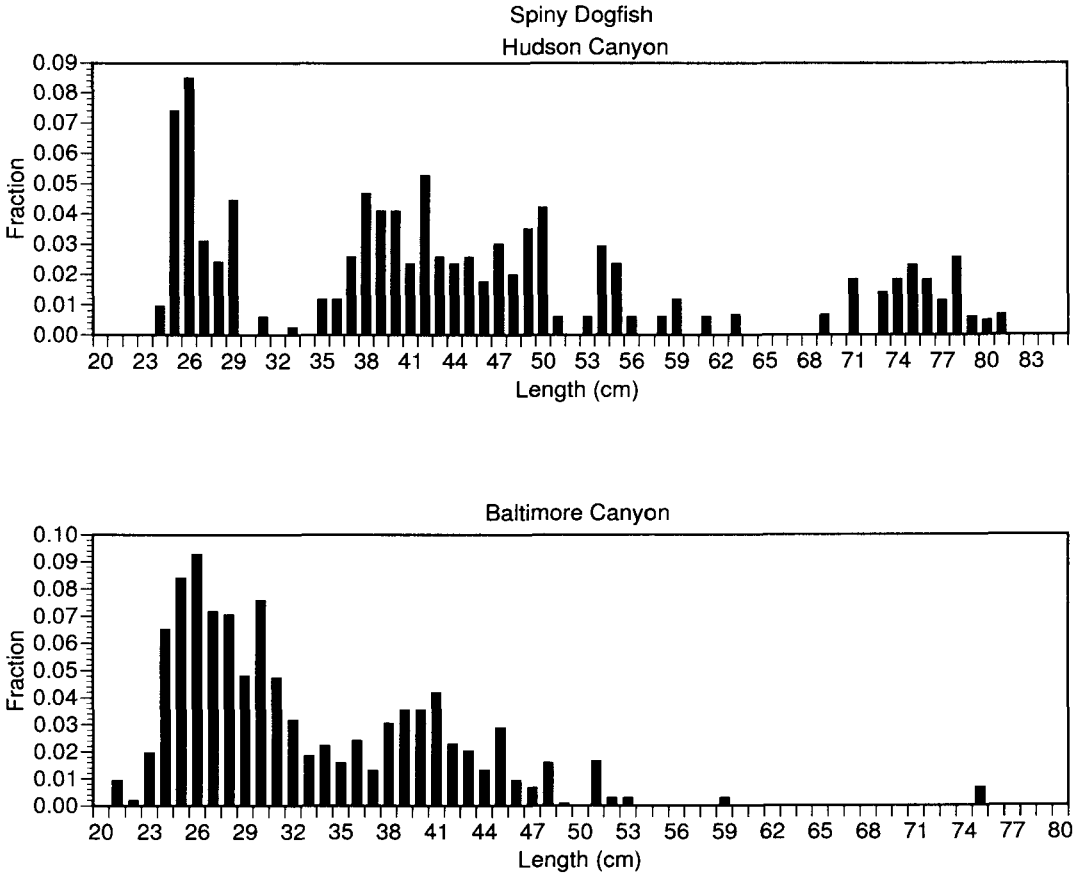


Figure 36a. Cumulative size-frequency distribution of summer flounder across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

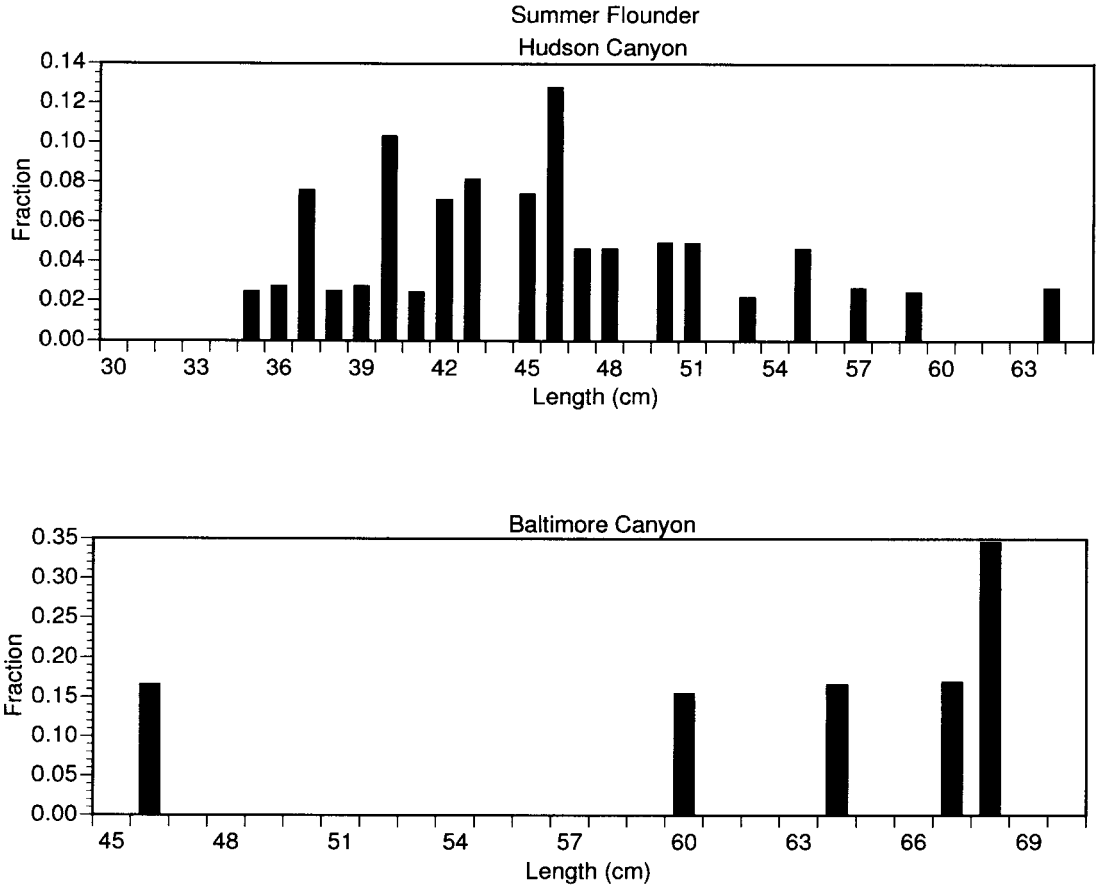


Figure 36b. Cumulative size-frequency distribution of summer flounder across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

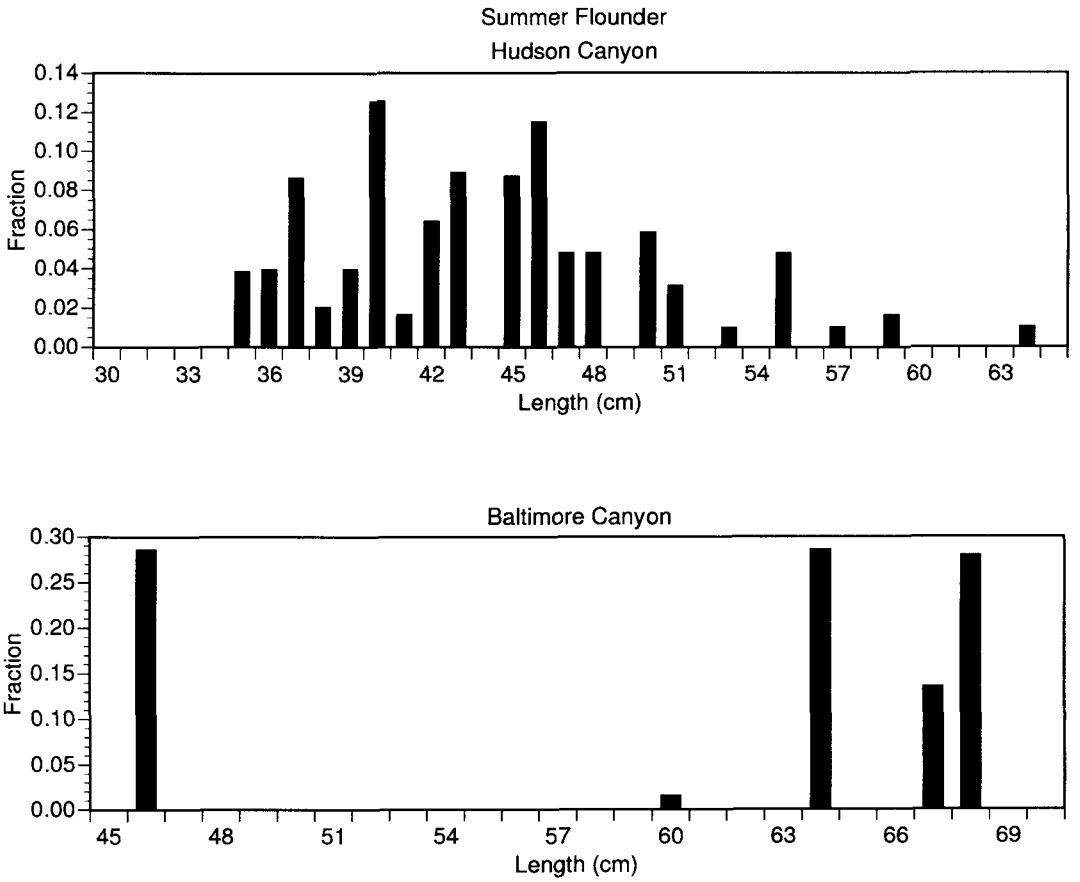


Figure 37. Cumulative size frequency, by tow, for black sea bassr, for tows with ≥ 20 measured individuals.

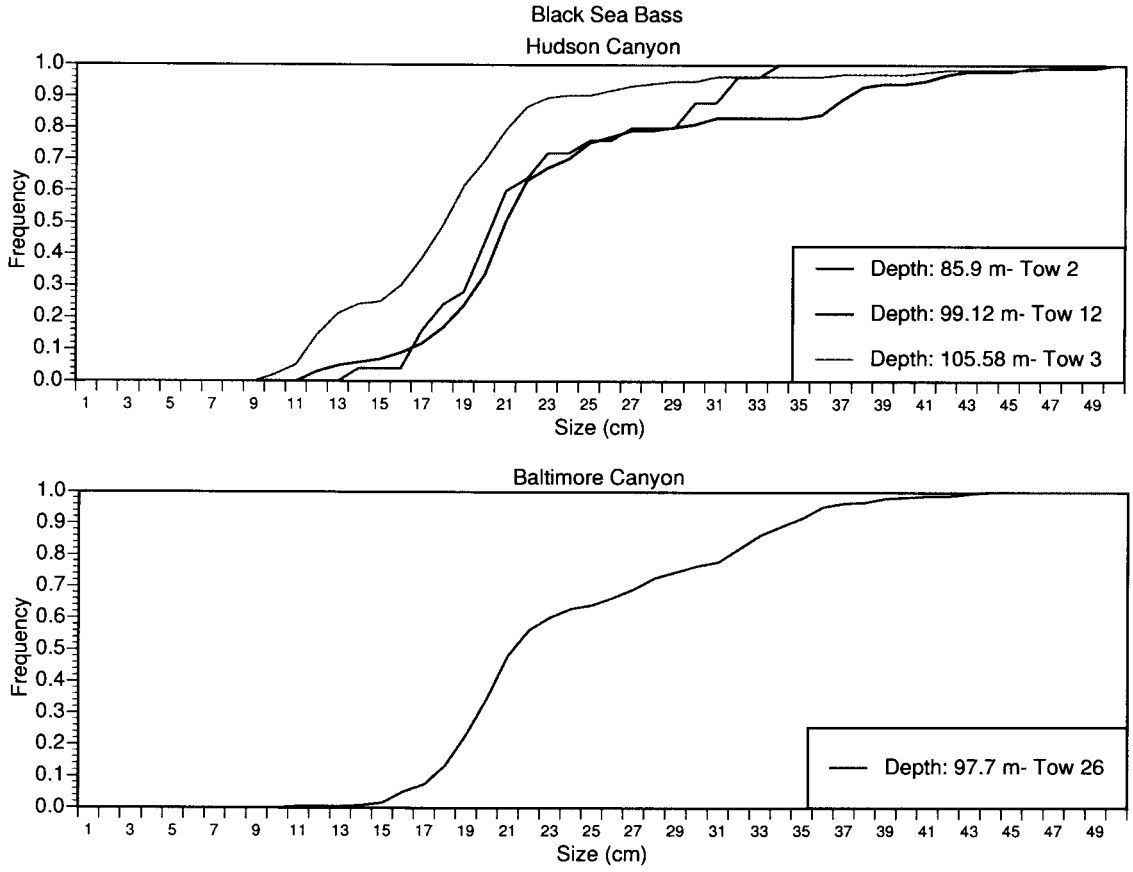


Figure 38. Cumulative size frequency, by tow, for *Illex* squid, for tows with ≥ 20 measured individuals.

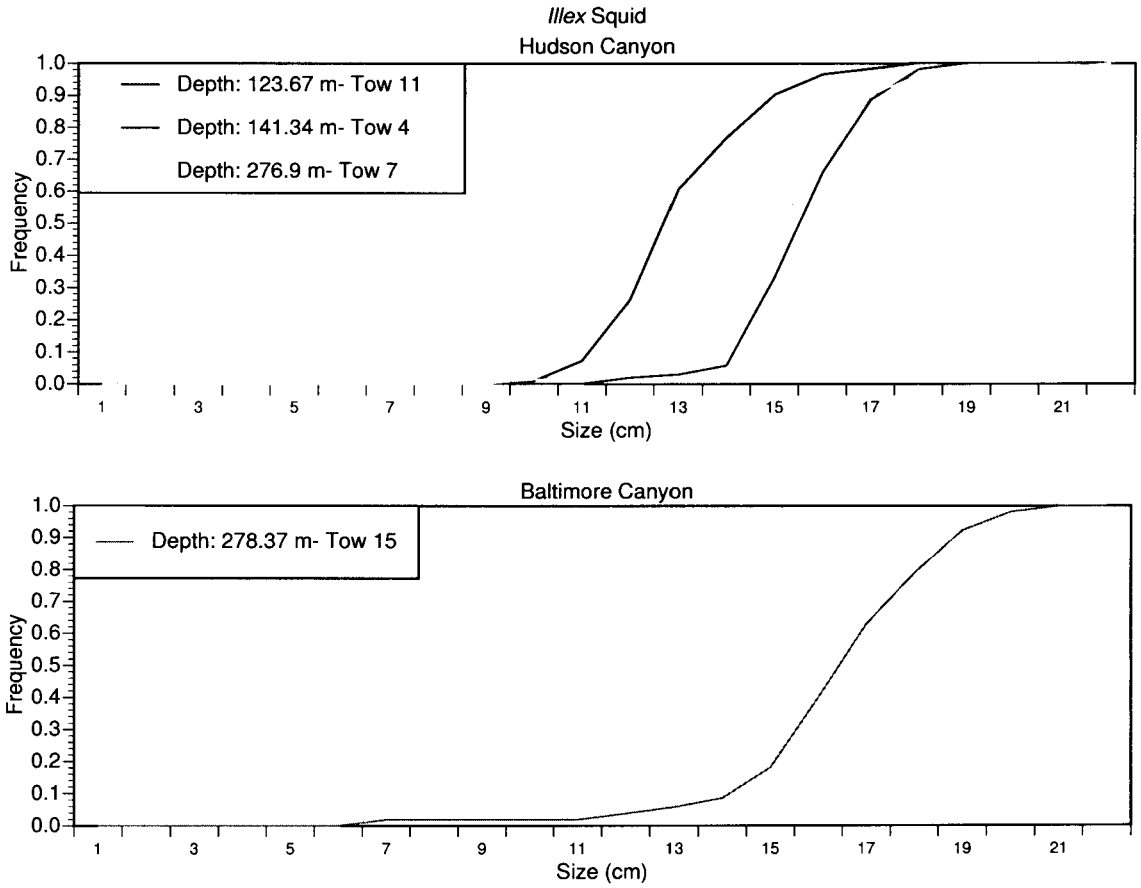


Figure 39. Cumulative size frequency, by tow, for *Loligo* squid, for tows with ≥ 20 measured individuals.

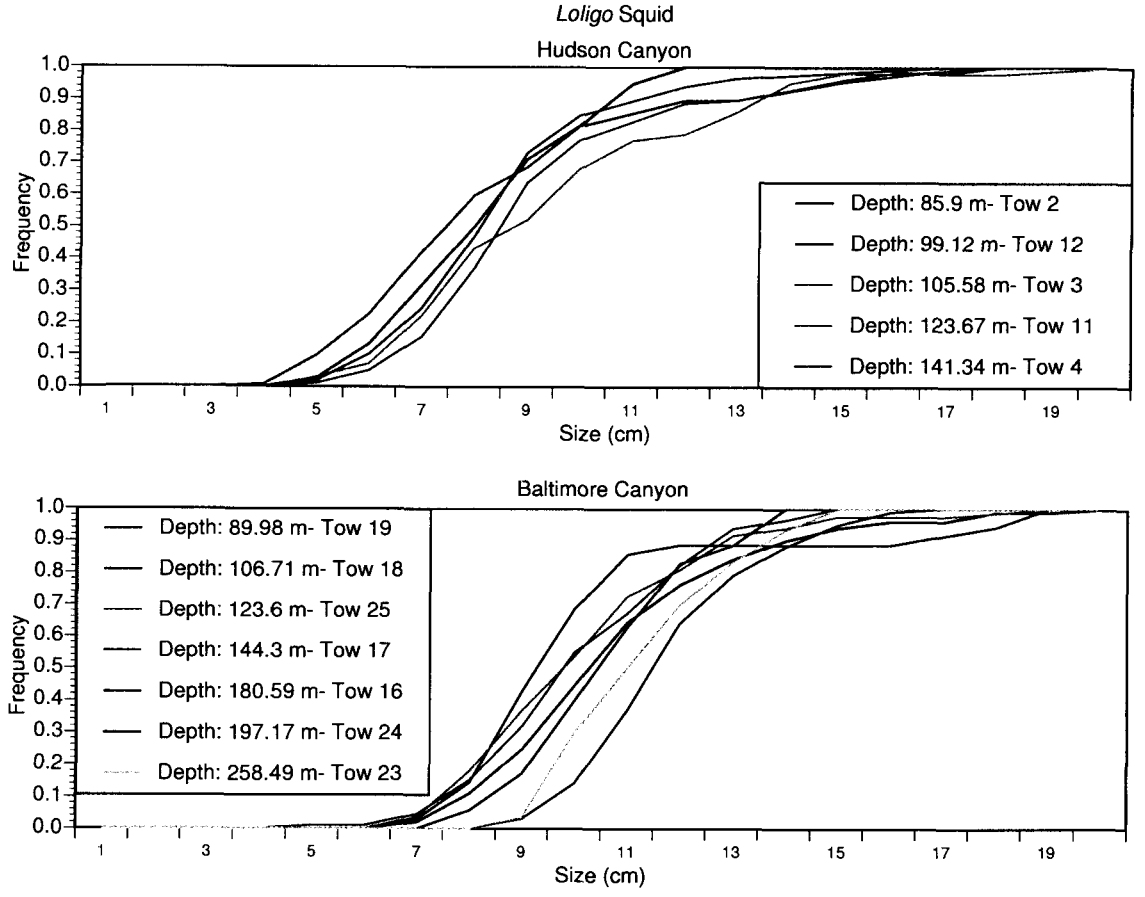


Figure 40. Cumulative size frequency, by tow, for monkfish, for tows with ≥ 20 measured individuals.

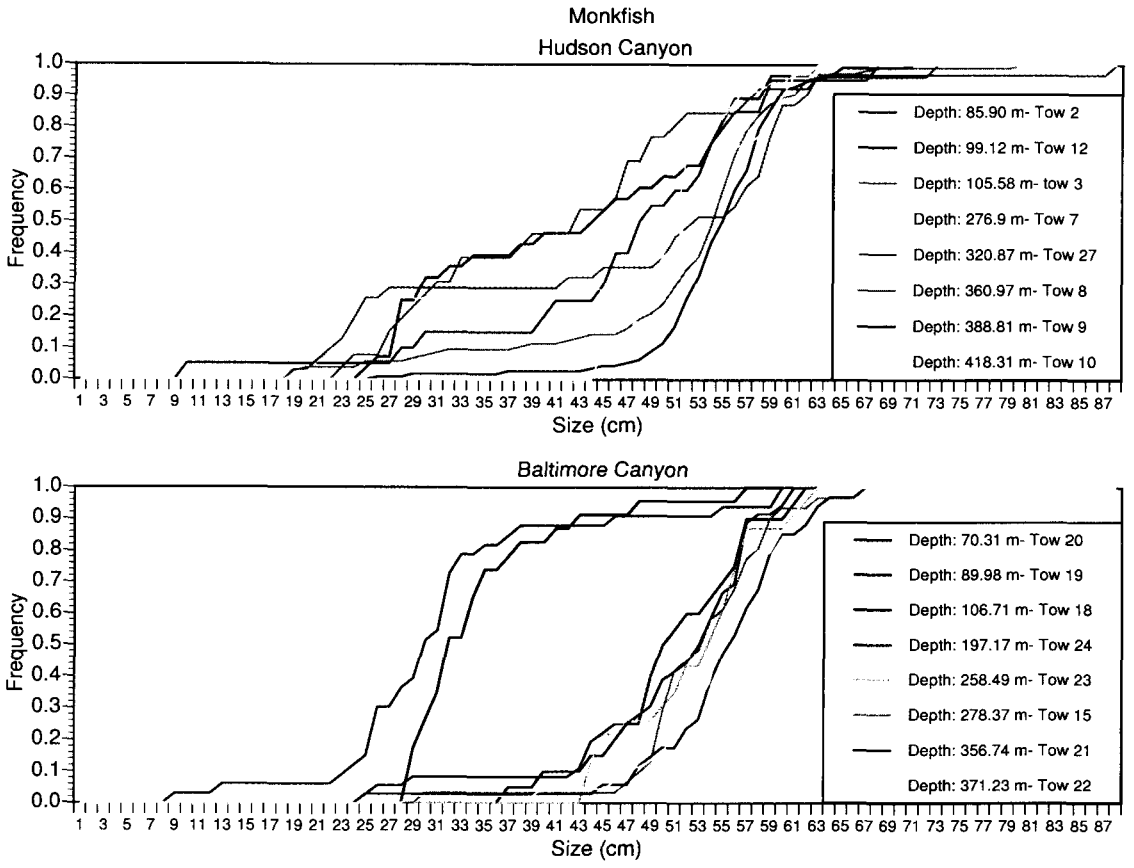


Figure 41. Cumulative size frequency, by tow, for offshore hake, for tows with ≥ 20 measured individuals.

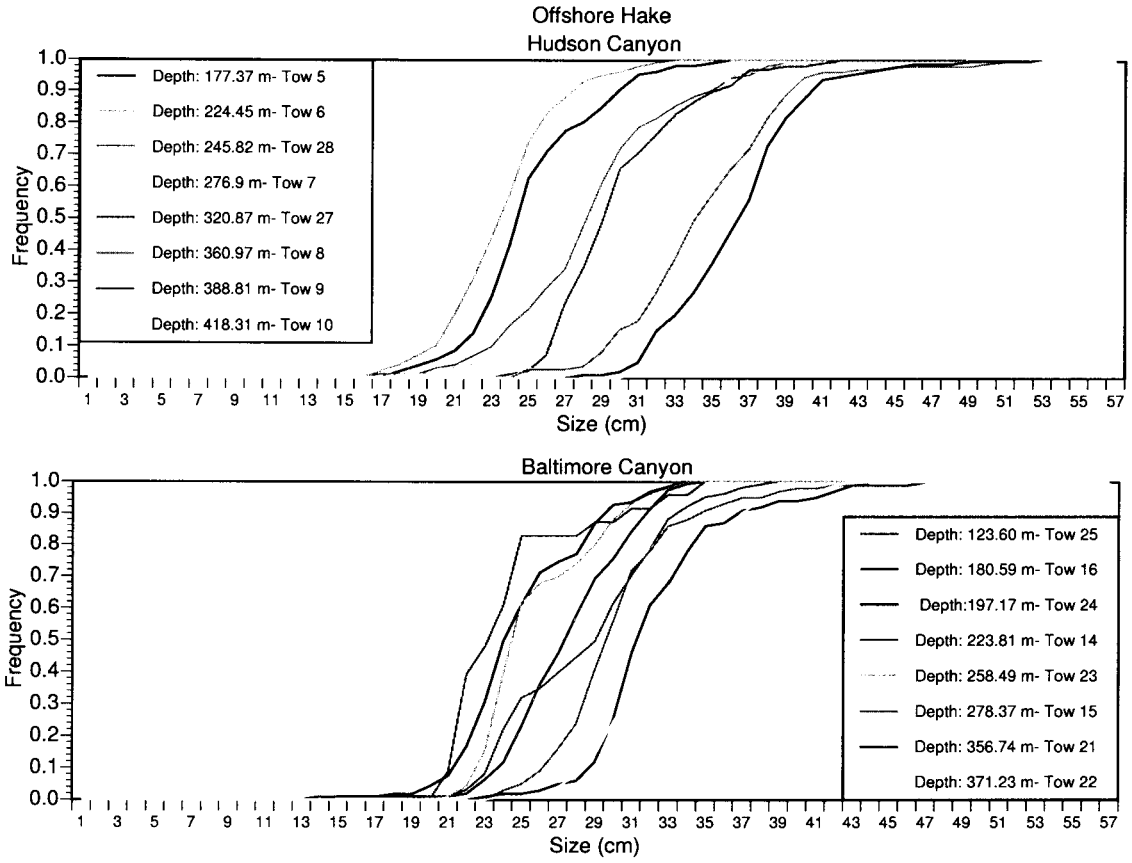


Figure 42. Cumulative size frequency, by tow, for scup, for tows with ≥ 20 measured individuals.

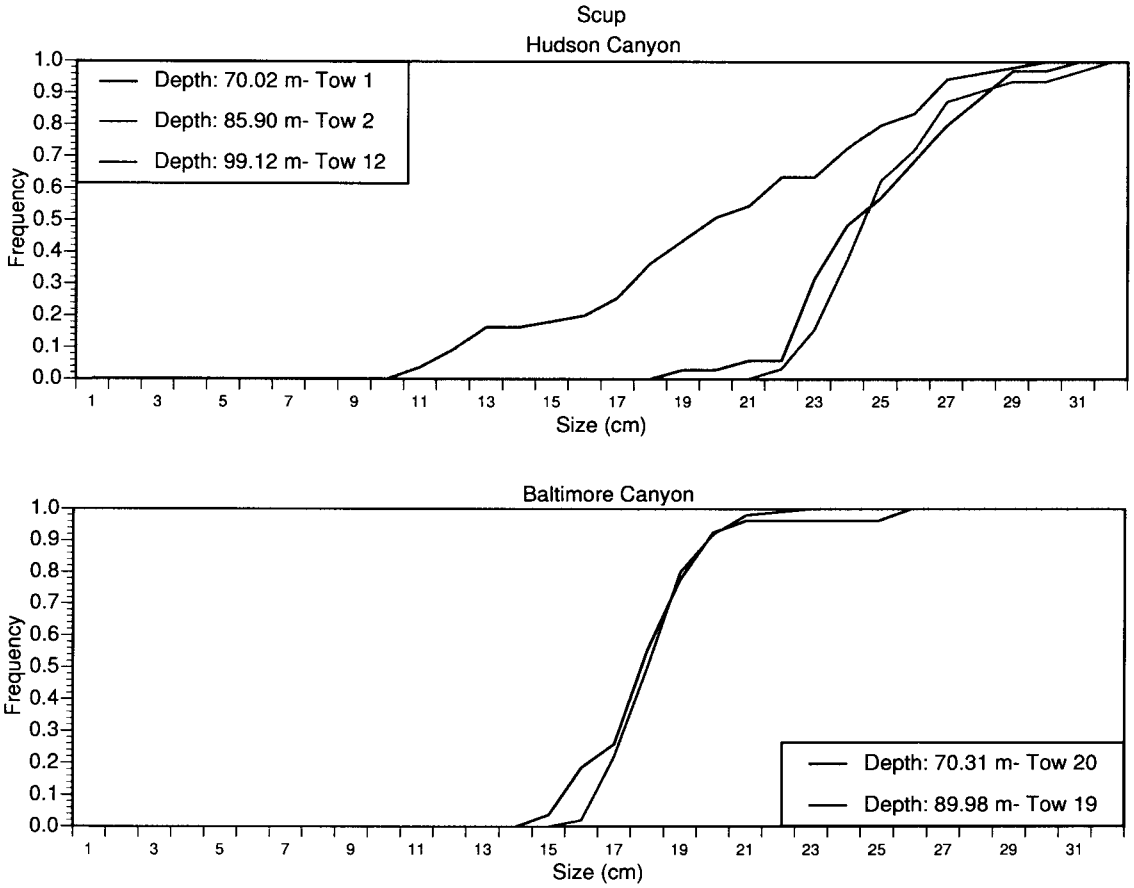


Figure 43. Cumulative size frequency, by tow, for silver hake, for tows with ≥ 20 measured individuals.

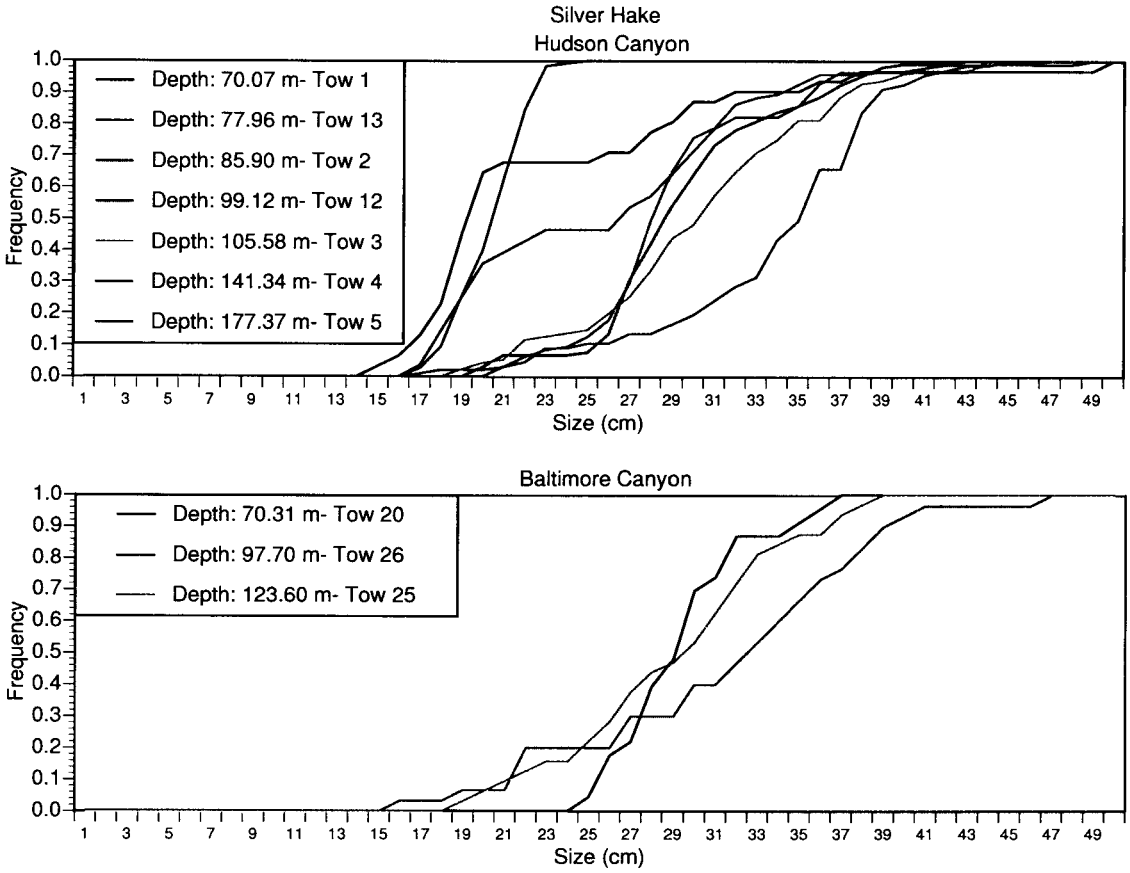


Figure 44. Cumulative size frequency, by tow, for spiny dogfish, for tows with ≥ 20 measured individuals.

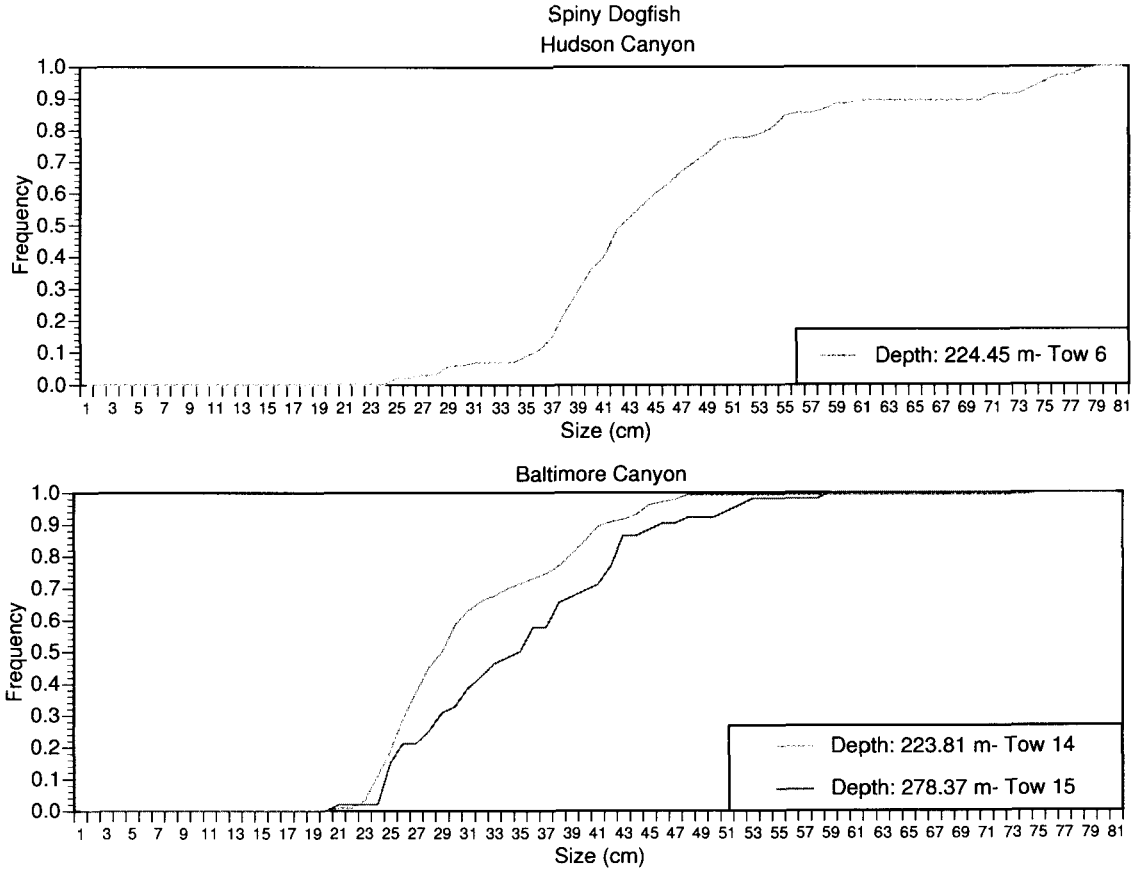
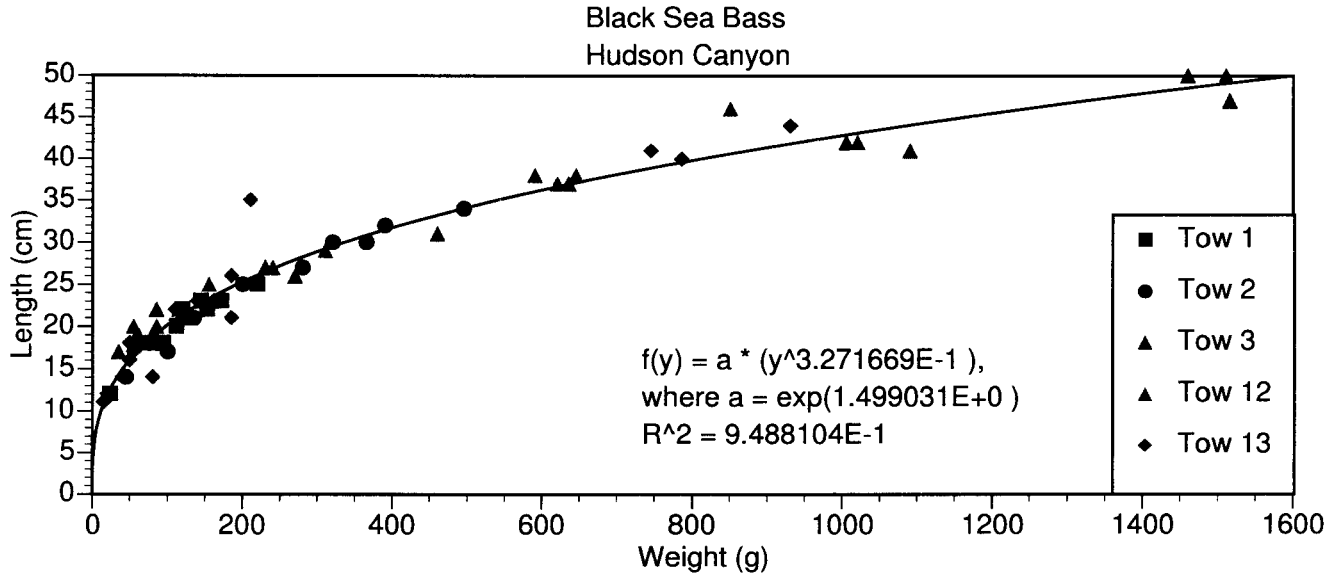


Figure 45. Relationship between length and weight for black sea bass caught during May 2003. f(y)= length, y=weight.



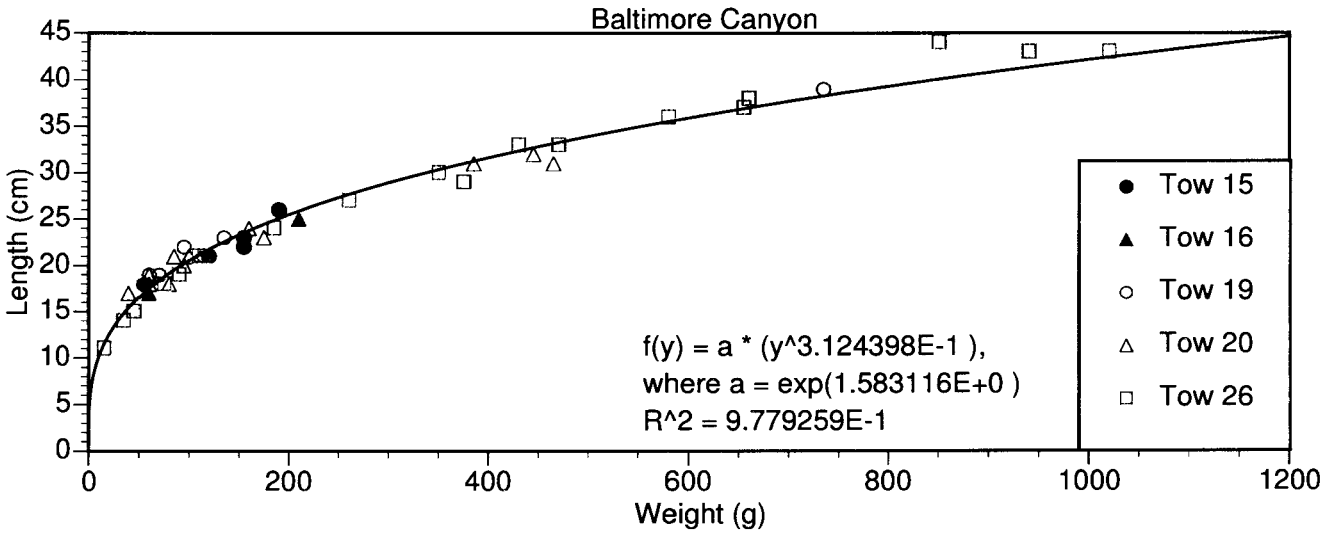
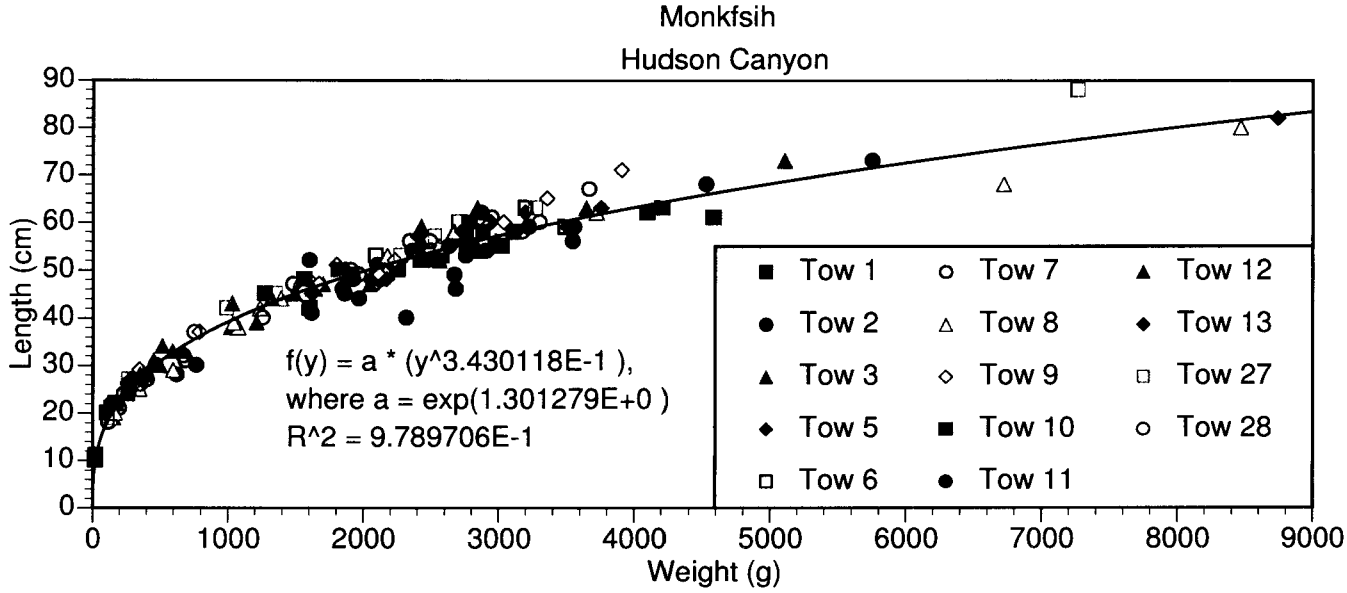


Figure 46. Relationship between length and weight for monkfish caught during May 2003. f(y)= length, y=weight.



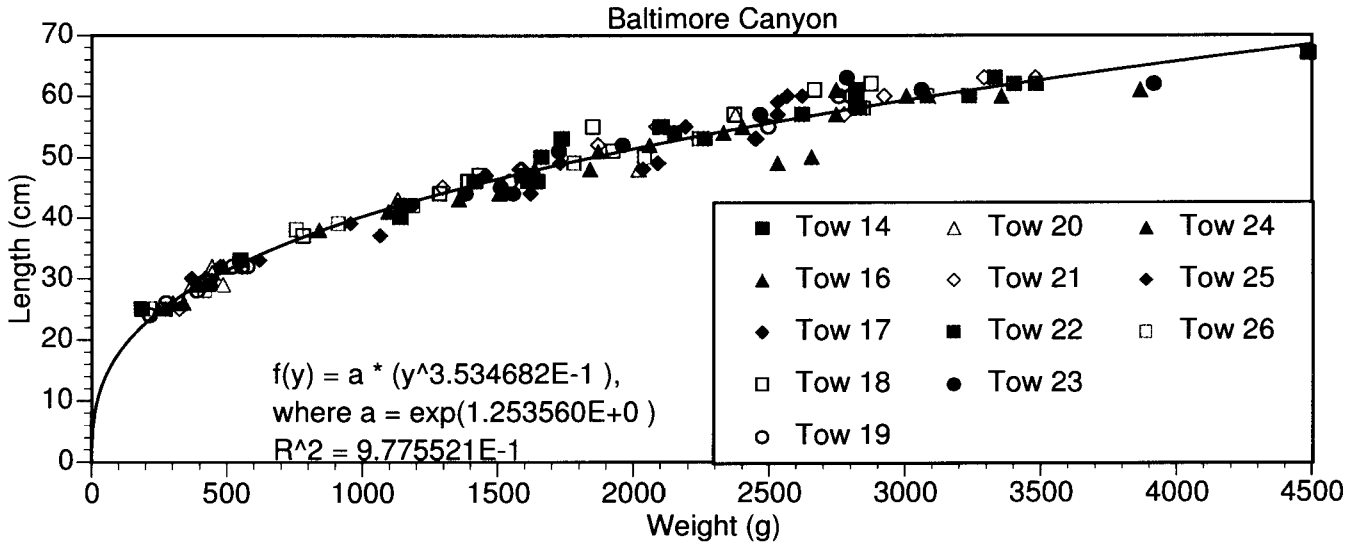
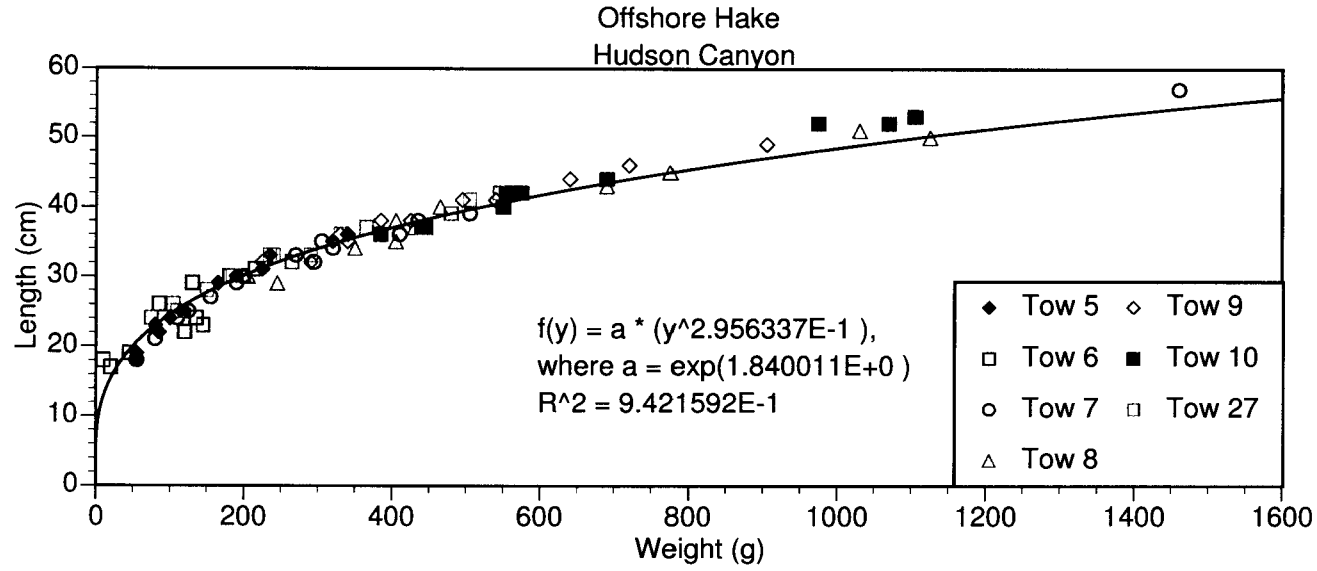


Figure 47. Relationship between length and weight for offshore hake caught during May 2003. f(y)= length, y=weight.



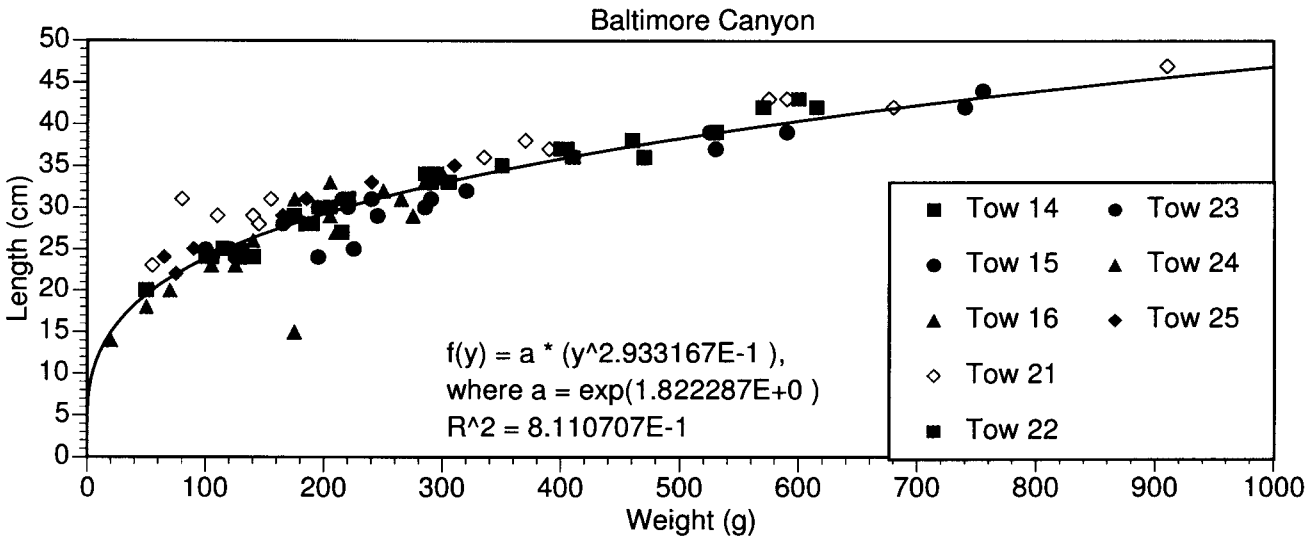
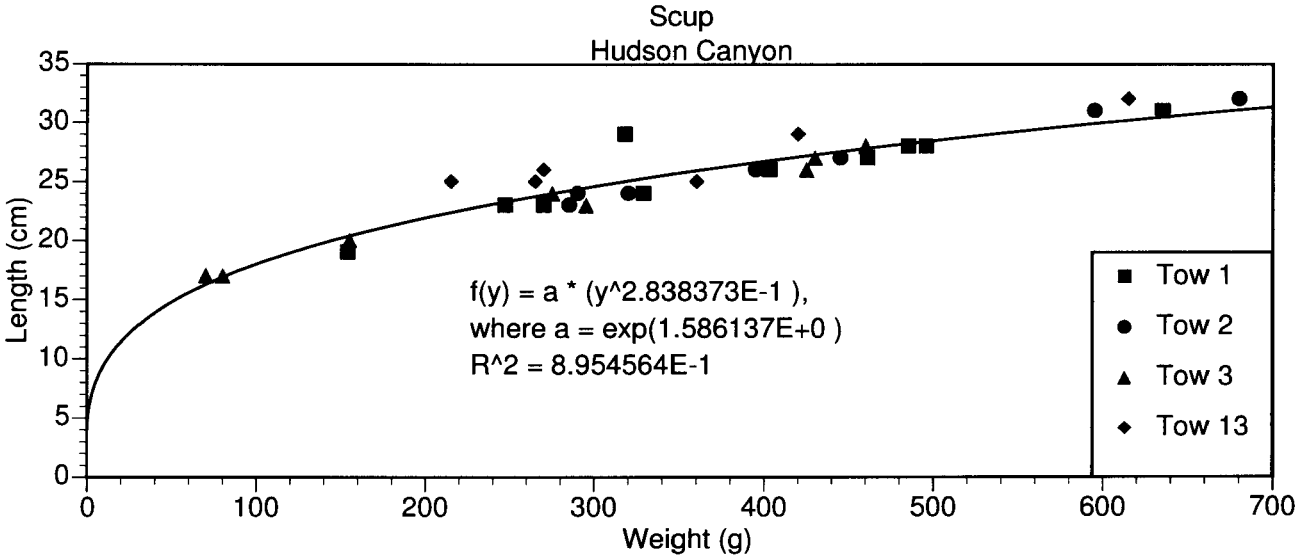


Figure 48. Relationship between length and weight for scup caught during May 2003. f(y)= length, y=weight.



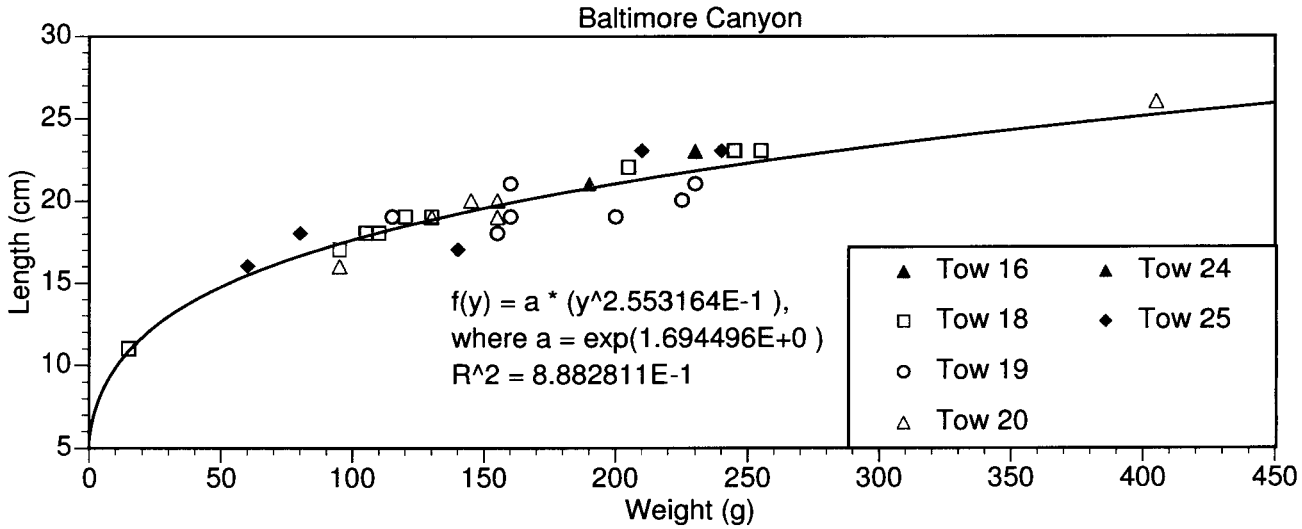
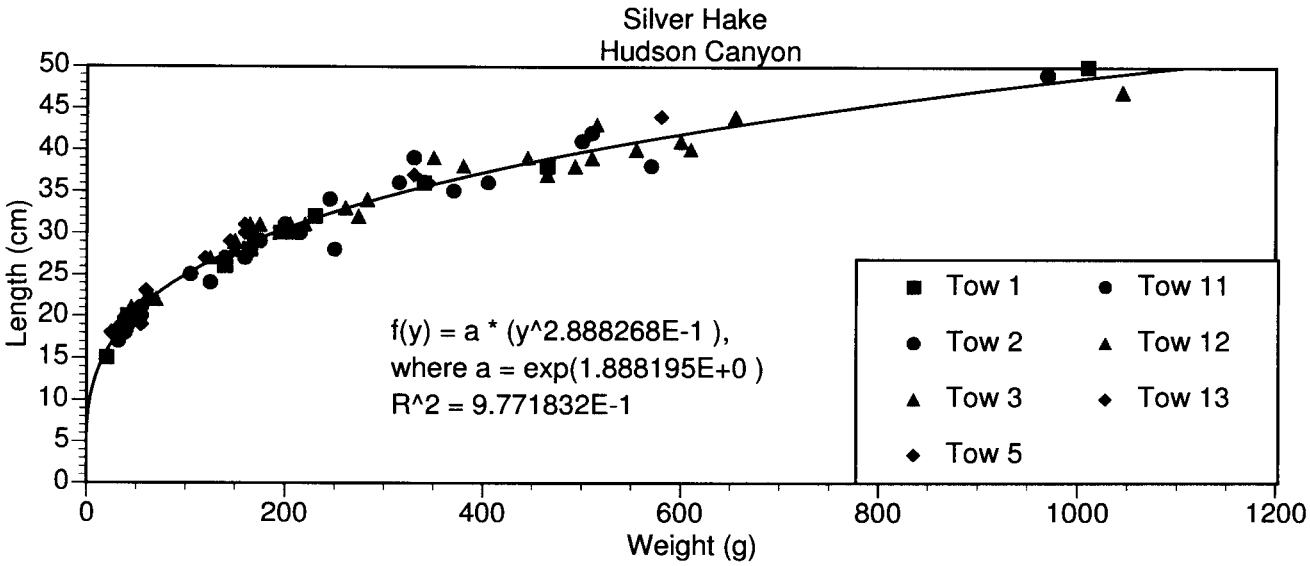


Figure 49. Relationship between length and weight for silver hake caught during May 2003. f(y)= length, y=weight.



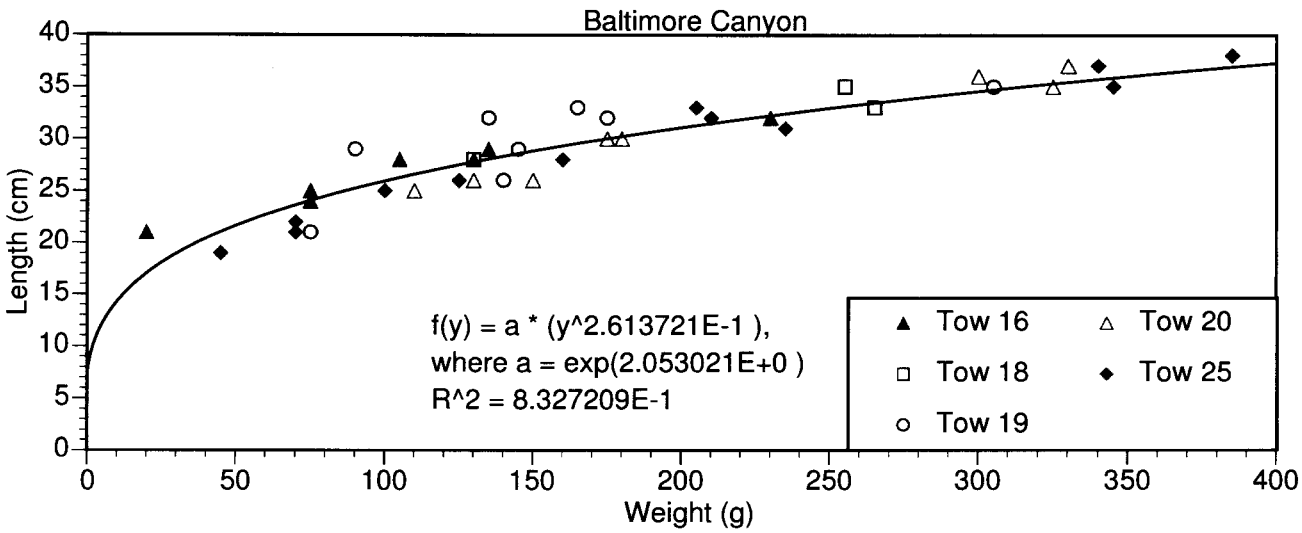
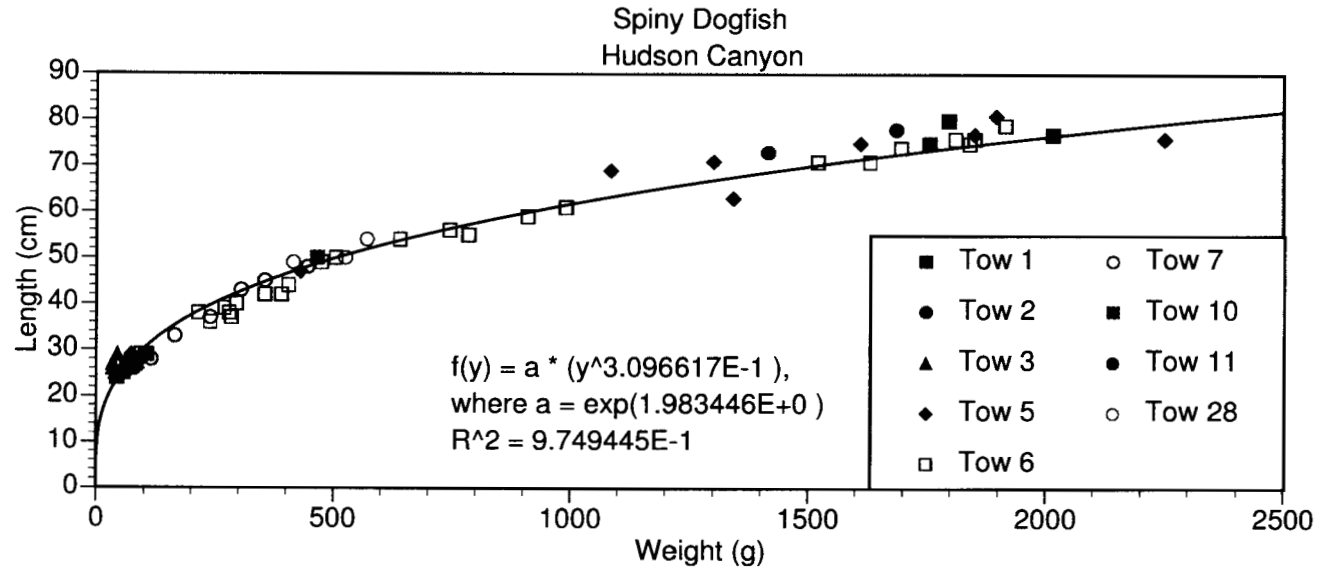


Figure 50. Relationship between length and weight for spiny dogfish caught during May 2003. f(y)= length, y=weight.



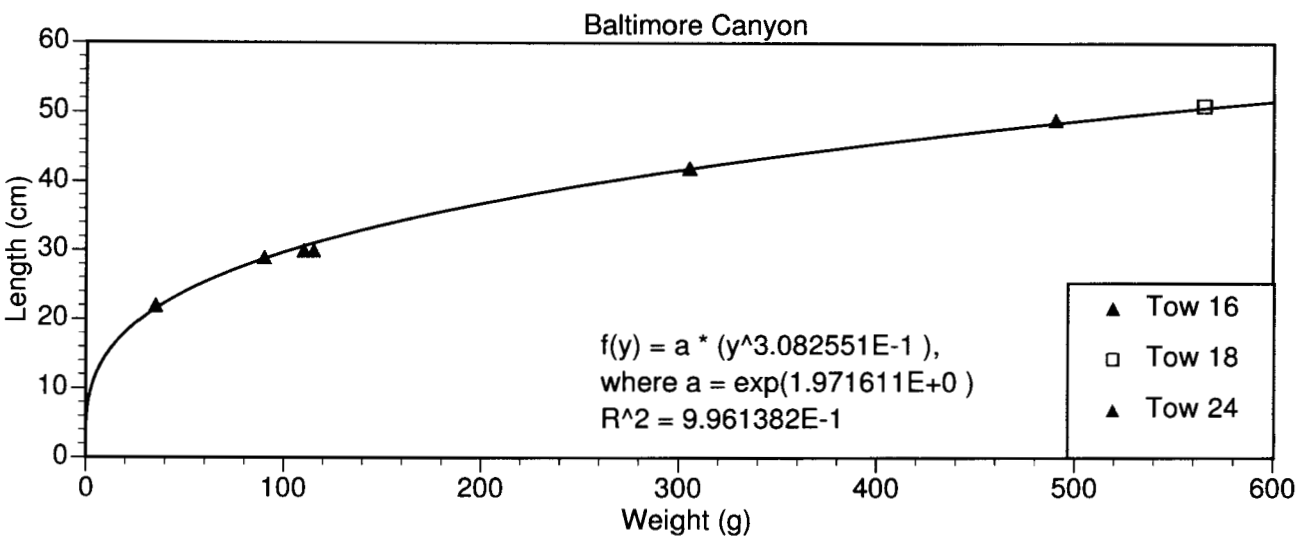
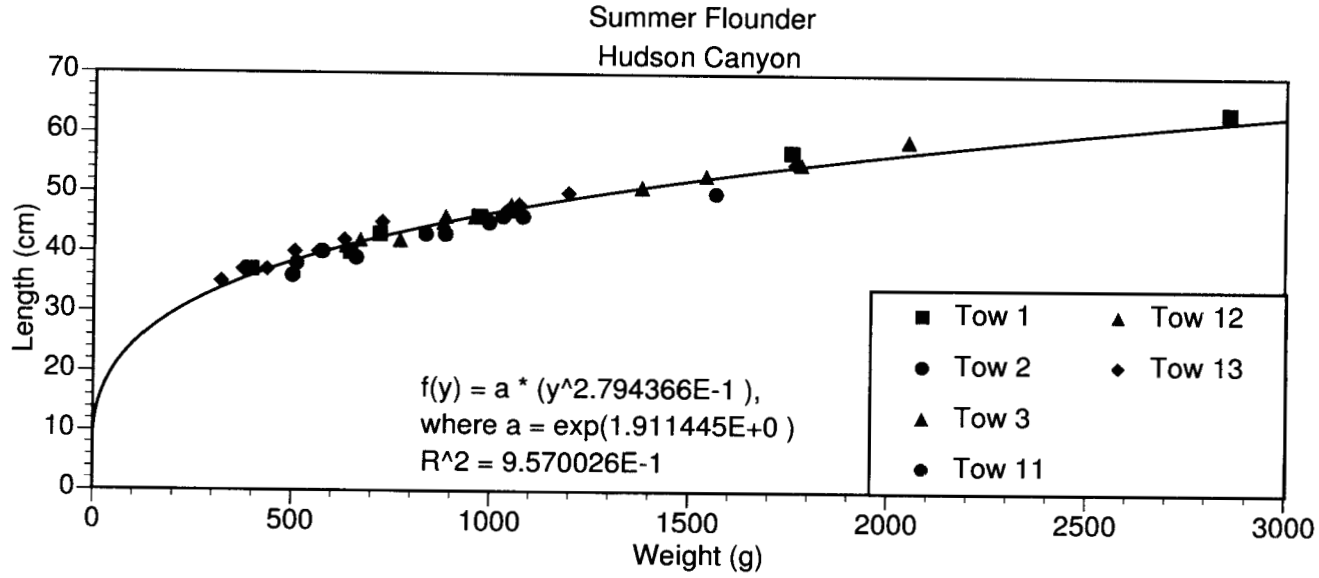


Figure 51. Relationship between length and weight for summer flounder caught during May 2003. f(y)= length, y=weight.



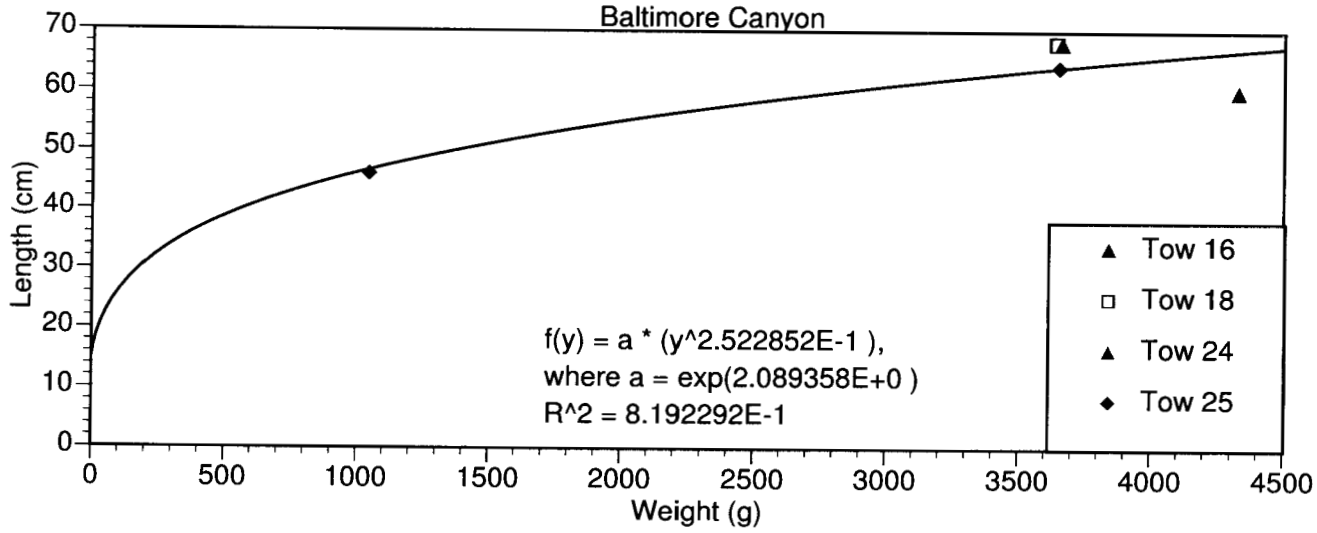


Figure 52a. Comparison of sampling performance data and temperature data from the March and May 2003 surveys. A slope of 1 (solid line) is expected if there is no change in sampling performance for temperature, scope and depth.

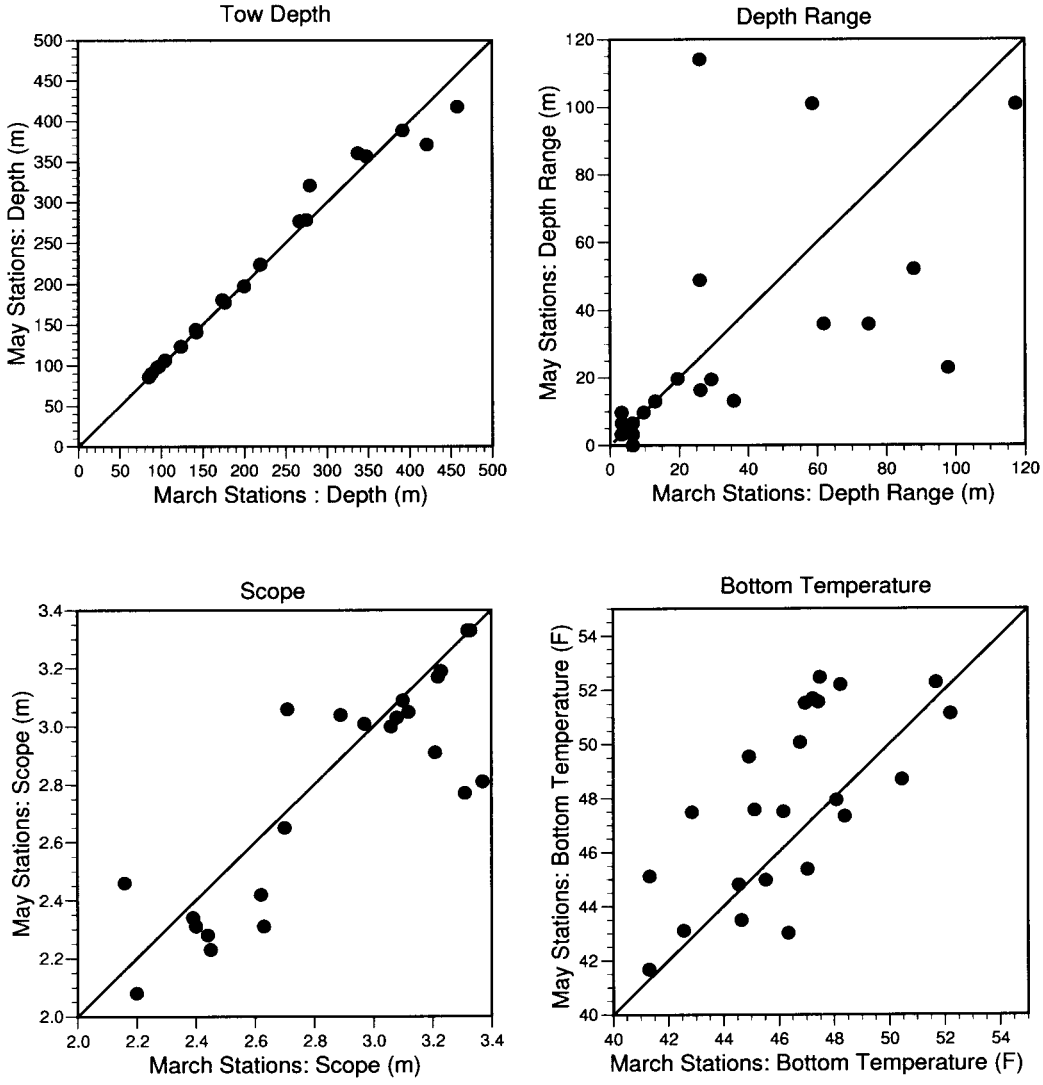


Figure 52b. Comparison of sampling performance data from the March and May 2003 surveys. A random distribution of points within a narrow two-dimensional field is expected if a change in sampling performance occurred.

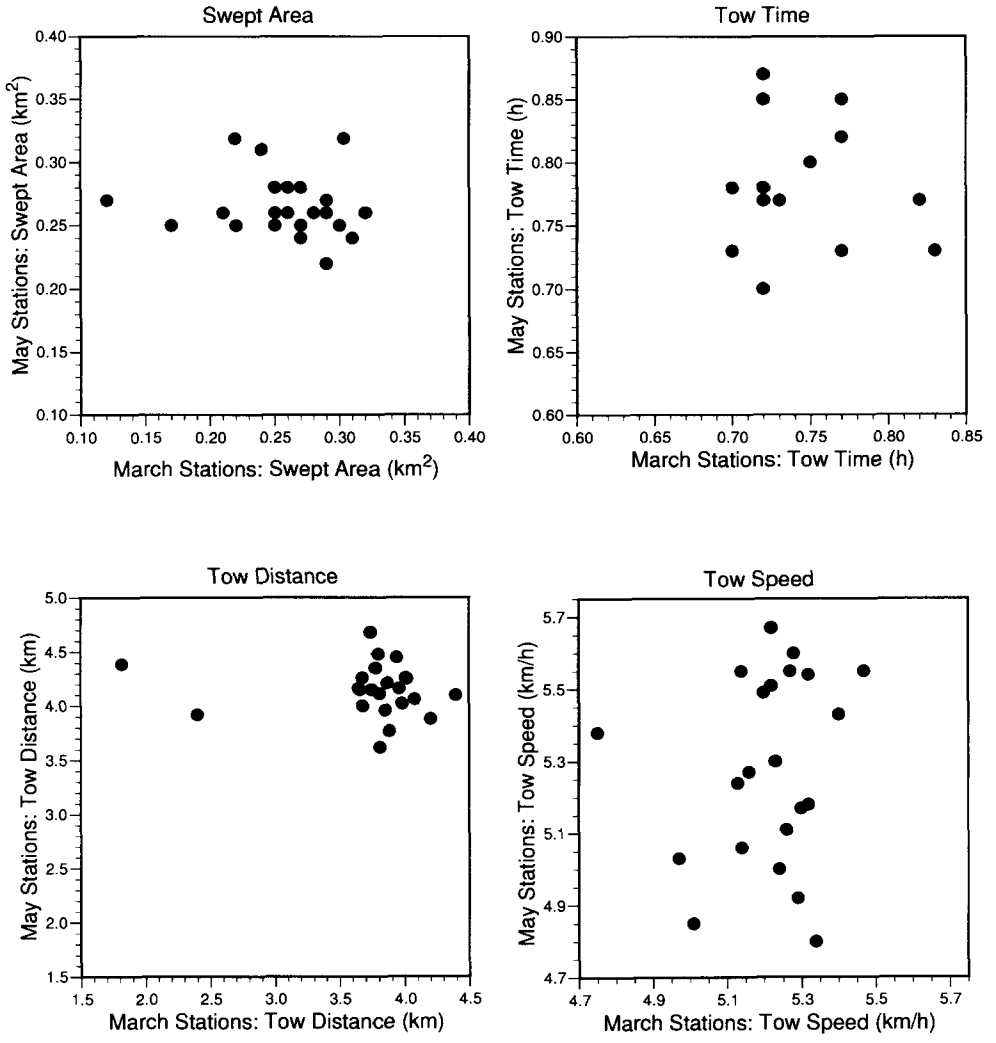


Figure 53. Changes in depth range and scope that occurred as tow depth increased during the May 2003 survey.

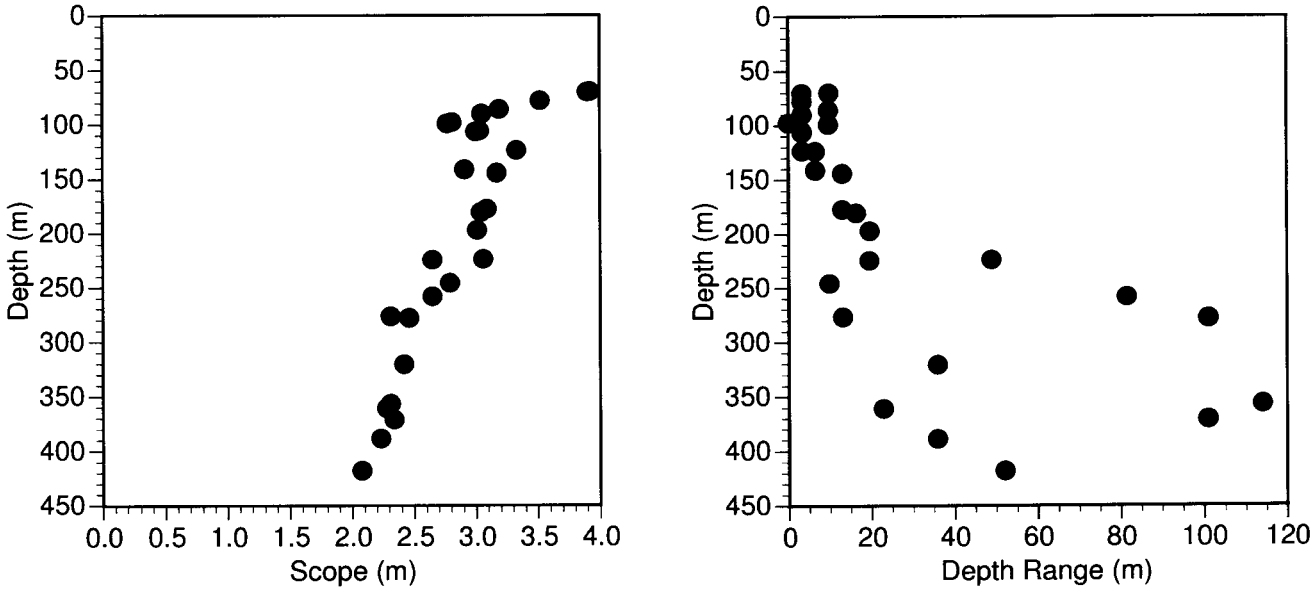


Figure 54a. Comparison of changes in depths for the 20th, 50th and 80th percentiles of cumulative catch during the March and May 2003 surveys. To calculate the percentiles, swath area catch (Figures 5b-25b) was cumulated from the shallowest to the deepest station on each transect. The 20th percentile, for eaample, is the depth where the cumulative catch curve reached 20% of the total catch.

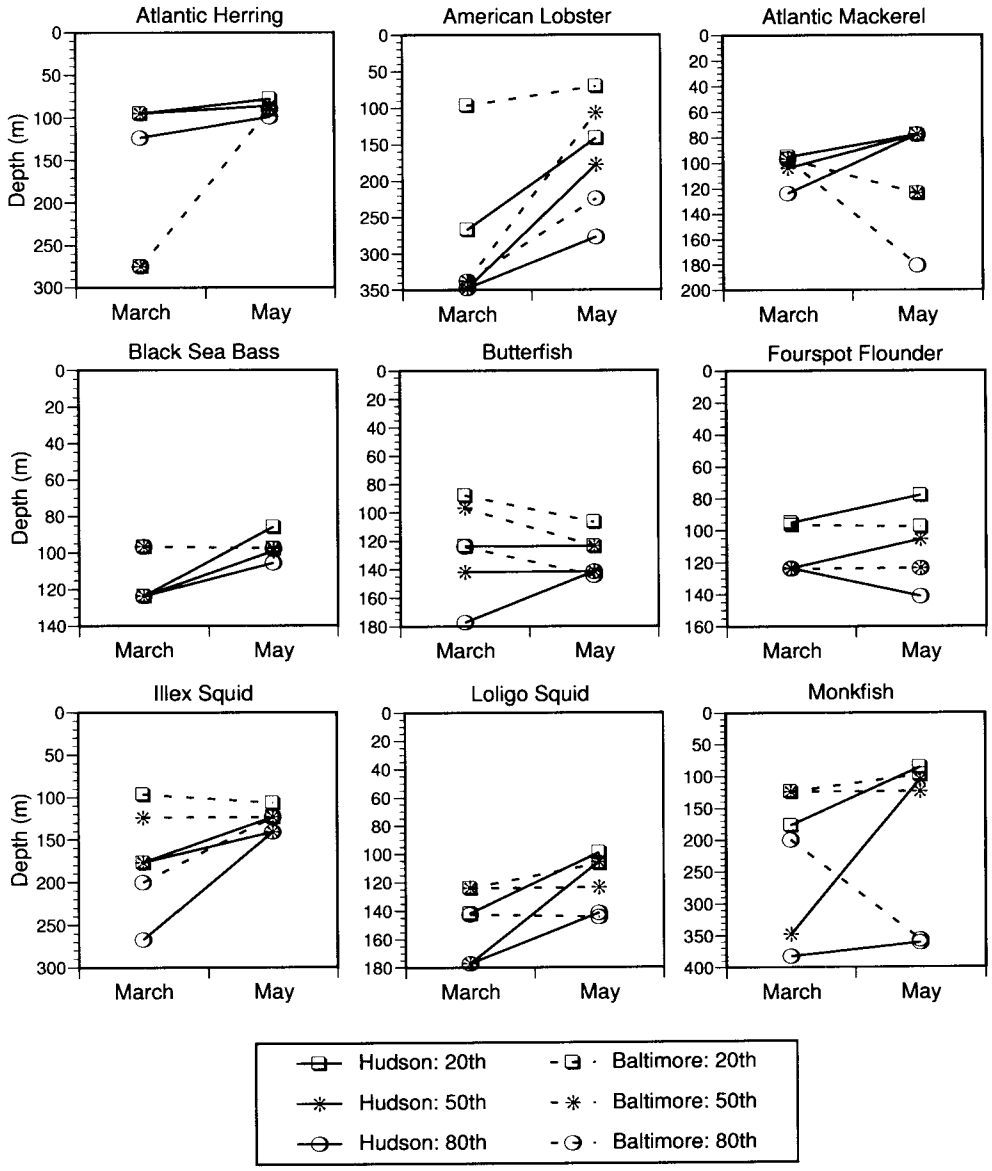
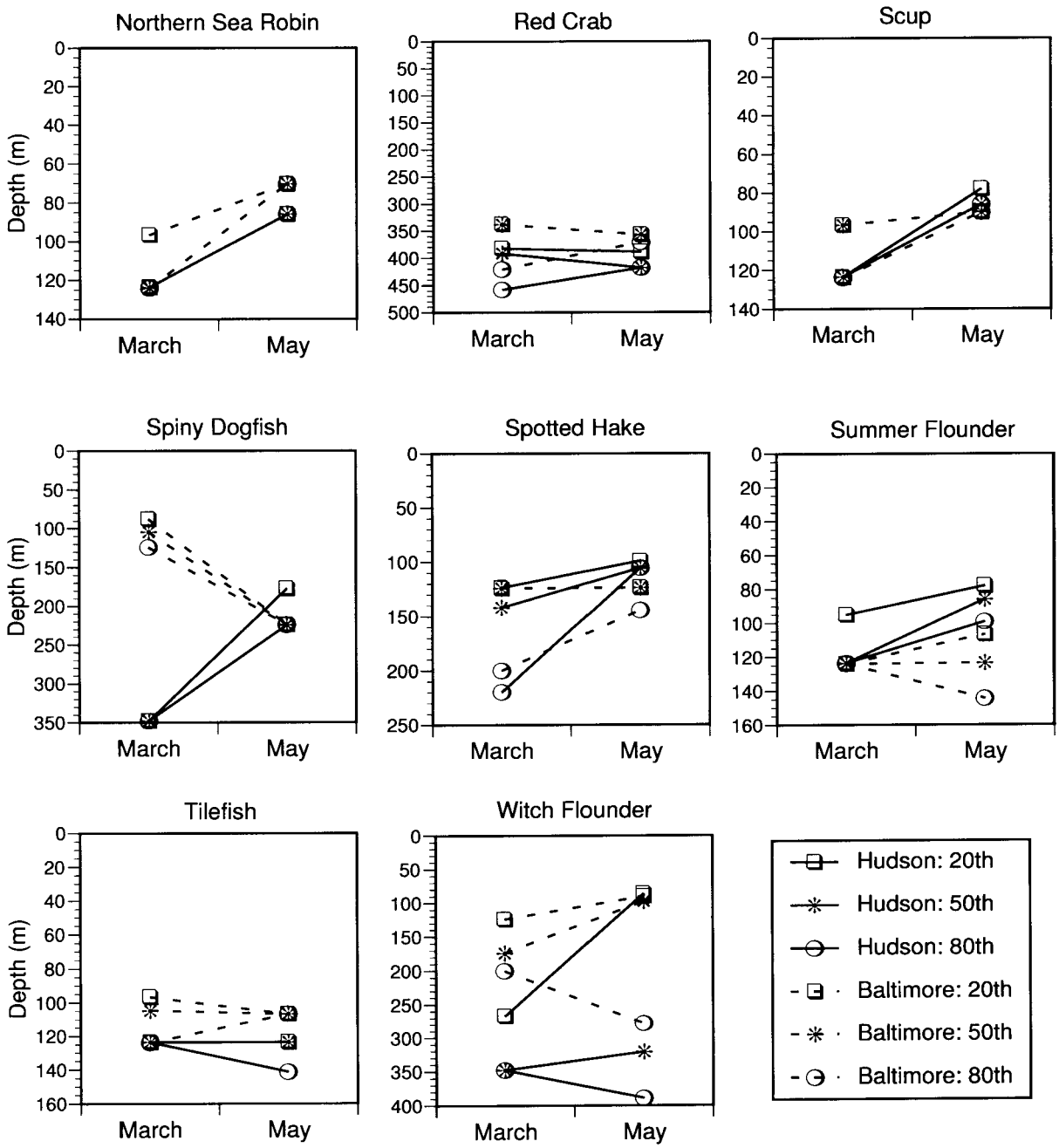


Figure 54b.


Northern Sea Robin
Red Crab
Scup
Spiny Dogfish
Spotted Hake
Summer Flounder
Tilefish
Witch Flounder
Depth (m)
March
May
Hudson: 20th
Hudson: 50th
Hudson: 80th
Baltimore: 20th
Baltimore: 50th
Baltimore: 80th

SFC
Approved 9/5/03
By Joyce Lacerda

Supplemental Finfish Survey Targeting Mid-Atlantic Migratory Species

March 2003 Cruise Report

1/1/03 - 6/30/03

Funded by the
MAFMC Research Set-Aside Program

National Fisheries Institute – Scientific Monitoring Committee
and
Haskin Shellfish Research Laboratory – Rutgers, The State University of New Jersey

March 2003 Supplemental Survey Cruise Report

The goals of the supplemental survey program are 1) to track the seasonal movements of selected fish species, particularly the fall offshore and downcoast migration coincident with declining temperatures and the spring upcoast and onshore migration that occurs as the water warms, and 2) to extend the supplemental survey beyond the domain of present-day NMFS-NEFSC surveys. As a consequence, the survey design includes spatial and temporal components, and sampling intensity is increased between 150 and 250 fm.

Organization of stations and target species

Stations are organized into cross-shelf transects oriented perpendicular to the average trend of the depth contours. The March survey sampled two fixed transects: oriented just east of Hudson Canyon (72°W) and just north of Baltimore Canyon (38°20′ N) (Figures 1 & 2). Stations were distributed by depth along each transect. Fixed stations were located at 50, 60, 80, 100, 125, 150, 200, 225 fm. A 250 fm tow was made along the Hudson Canyon transect. Fixed stations on the Baltimore Canyon transect were located at 50, 60, 80, 100, 125, 150, 200, and 225 fm. The 250 fm station was not occupied on the Baltimore Canyon transect due to the steep depth gradient in the area.

An additional four adaptive stations were sited in an unbiased way while at sea based on the catches of target species at the fixed stations. Target species were summer flounder, scup, black sea bass, monkfish, and spiny dogfish. To create adaptive stations, fixed stations providing the highest overall ranking based on the catch of target species were identified. Adaptive stations were placed one-half depth increment between fixed station pairs that had the highest combined station ranks based on the sum of the target species ranks at each station until all four adaptive stations were allocated. An example in the form of an Excel spreadsheet is presented as Figure 3.

Hudson Canyon

Fixed Stations

	Starting Position		Ending Position		Depth	
Station #	Latitude	Longitude	Latitude	Longitude	Average	(Target)
1	39° 38.049′	71° 56.347′	39° 36.112′	71° 56.975′	222 fm	(225 fm)
2	39° 38.112′	71° 56.941′	39° 36.292′	71° 58.021′	197 fm	(200 fm)
3	39° 40.788′	71° 57.483′	39° 38.915′	71° 58.601′	150 fm	(150 fm)
4	39° 39.619′	71° 59.415′	39° 37.735′	72° 00.601′	124 fm	(125 fm)
5	39° 39.336′	72° 01.223′	39° 41.162′	71° 59.977′	100 fm	(100 fm)
6	39° 42.089′	72° 03.507′	39° 40.350′	72° 05.063′	80 fm	(80 fm)
7	39° 45.733′	72° 08.218′	39° 44.404′	72° 10.130′	60 fm	(60 fm)
8	39° 48.276′	72° 08.842′	39° 48.013′	72° 11.374′	50 fm	(50 fm)
21	39° 37.530′	71° 55.001′	39° 39.447′	71° 55.210′	260 fm	(250 fm)

Adaptive Stations

Station #	Latitude	Longitude	Latitude	Longitude	Average	(Target)
22	39° 37.978′	71° 56.476′	39° 36.073′	71° 57.677′	213 fm	(212 fm)
23	39° 38.474′	71° 59.494′	39° 36.713′	72° 00.981′	137 fm	(137 fm)
24	39° 42.877′	72° 05.186′	39° 41.292′	72° 06.673′	70 fm	(70 fm)
25	39° 45.609′	72° 10.578′	39° 46.438′	72° 07.963′	55 fm	(55 fm)

Baltimore Canyon

Fixed Stations

	Starting Position		Ending Position		Depth	
Station #	Latitude	Longitude	Latitude	Longitude	Average	(Target)
9	38° 17.166′	73° 36.770′	38° 16.440′	73° 37.530′	152 fm	(150 fm)
10	38° 16.637′	73° 36.315′	38° 17.732′	73° 35.776′	240 fm	(225 fm)
11	38° 17.198′	73° 37.182′	38° 15.540′	73° 38.634′	126 fm	(125 fm)
12	38° 17.857′	73° 37.206′	38° 19.314′	73° 35.485′	99 fm	(100 fm)
13	38° 17.844′	73° 37.861′	38° 16.142′	73° 39.272′	81 fm	(80 fm)
14	38° 16.554′	73° 46.906′	38° 17.921′	73° 44.641′	60 fm	(60 fm)
15	38° 21.857′	73° 45.233′	38° 23.207′	73° 43.365′	50 fm	(50 fm)
16	38° 18.181′	73° 35.584′	38° 18.925′	73° 33.240′	191 fm	(200 fm)

Adaptive Stations

Station #	Latitude	Longitude	Latitude	Longitude	Average	(Target)
17	38° 17.201′	73° 37.472′	38° 15.546′	73° 38.812′	112 fm	(112 fm)
18	38° 20.054′	73° 33.561′	38° 18.501′	73° 34.865′	164 fm	(175 fm)
19	38° 20.962′	73° 36.729′	38° 19.500′	73° 38.461′	70 fm	(70 fm)
20	38° 22.595′	73° 42.779′	38° 23.817′	73° 40.767′	55 fm	(55 fm)

Station Sampling Protocol

Site selection for the first occupation of fixed and adaptive stations was made as follows. A specified location was chosen *a priori* based on bathymetric charts. The vessel steamed to the location. The Captain was then permitted to search an area of approximately 1 nautical mile in diameter to identify a satisfactory location for the tow. One adaptive station on the Hudson Canyon transect could not be occupied due to lobster pots (target depth 175 fm) and one station could not be sampled on the Baltimore Canyon transect due to the rapidly changing depths (target depth 212.5 fm). In these cases, the 5^{th}ranking intermediate location was chosen as the 4^{th}adaptive station to keep the desired number of adaptive stations.

Tows were a fixed distance of 2 nautical miles. Tow speed was maintained near 3 knots. Tows were oriented along-slope to the extent possible, unless local conditions dictated a different approach. DGPS position was logged to 0.01′ latitude and longitude every 1 minute during the tow. Depth, door spread, bottom temperature, GMT, and GPS position were logged manually every 5 minutes by the captain. Depth and bottom water temperature were logged remotely at 1-minute intervals using a Vemco sensor attached to the top of the codend.

Gear

The target species included a combination of groundfish and other species. To permit efficient capture of groundfish while also maintaining a reasonable degree of catchability for other species such as scup, a 4-seam box net with a standard 6-cm codend (liner) was used. The fishing circle of the net is 506 meshes of 6″ mesh. The extension of the net is 3″ mesh knot to knot, 100 meshes long, and 225 meshes around. The codend is made of 6.5″ mesh knot to knot, 100 meshes long, 70 meshes around, and is lined with a 6-cm mesh liner. The chaffing gear is a mat made of 6″ mesh covering 2/3 of the bottom of the codend. The doors are 104″ Thyboron with a spoiler. Each door weighs 1640 pounds. The footrope is constructed from 114′ 6.5″ × 1/2″ stainless steel wire wrapped with #12 polyester with 2 wire extensions of 6′ 5.16″ eye to eye joined with two 3/4″ bow shackles for an overall length of 127′ 11″. The headrope is 117′ 11.52″ overall length, including the extensions. There are 92 8″ hi-impact floats hung in groups of 6 on 5/8″ poly plus, grouped closely together in the center with a set of 6 on each wing. The traveler is made of 1/2″ stainless steel wire banded with 1/2″ stainless steel bands to the footrope. The overall length is 119′, with the stainless steel bands spaced at 1′ 11″ intervals. The sweep is made up of 5/8 stainless steel wire with 84 1.4 pound leads in the center section and 3 link 1/2″ trix drop chains at 1′ 11″ intervals throughout. The sweep is in three sections joined with 1/2″ hanging locks and 2′ 6″ of 1/2″ trix chains on each wing end. Each wing is 46′ 6.84″ eye to eye and the bosom is 29′ 2.28″ eye to

eye. The sweep is covered with 3″ rubber cookies.

Sample Processing Protocol

Sample processing protocol followed standard NMFS survey methods. Each tow was sorted to species and catch weights were obtained for each species. These species included: summer flounder, scup, black sea bass, monkfish, spiny dogfish, skates, yellowtail flounder, winter flounder American lobster, and *Loligo* squid. Priority species were then measured. The goal for each priority species was 100 length measurements for each tow. If fewer than 100 individuals were caught, all of the individuals were measured. Each priority species was then divided into size classes and the first 3 individuals measured in each size class were weighed. Summer flounder, monkfish, and spiny dogfish were divided into 10-cm size classes. Scup, black sea bass, and *Loligo* squid were divided into 5-cm size classes. For skates and American lobster, all of the individuals were measured. Neither yellowtail flounder nor winter flounder were caught in any of the tows. Personnel availability limited the amount of biological sampling done on the March survey, but scale samples were taken from large scup (> 25 cm) and black sea bass (>40 cm), and scale and otolith samples were taken from large summer flounder (> 60 cm).

Species	# Length Measurements	# Weight Measurements	# Samples Taken/Type
Loligo squid	1863	263	0
Spiny dogfish	1059	240	0
Monkfish	756	259	0
Summer flounder	565	124	61/ Scales 61/Otoliths
Black sea bass	510	120	26/ Scales
Scup	299	45	1/ Scales
American lobster	99	62	0
Thorny skate	14	14	0
Smooth skate	12	12	0
Clearnose skate	9	9	0
Barndoor skate	3	3	0
Winter skate	1	1	0

Results

A total of 25 tows were made during the March 2003 survey. Thirteen tows were taken along the Hudson Canyon transect and 12 along the Baltimore Canyon transect. Due to the rapidly changing depth contours in Baltimore Canyon, it was difficult to maintain a constant depth in the deep-water stations. Nevertheless, the average tow depths were relatively close to the target depths for all tows (Table 1). Lobster gear was encountered on the 150 fm tow in Baltimore Canyon, and the

tow was hauled early. The 225 fm Baltimore Canyon tow was hauled early as well because the net encountered the canyon wall. Almost all of the tows lasted about 40-50 minutes and covered approximately 3.5-4 km.

Table 1 presents the basic tow information for each tow. Average depth was calculated as the average of all of the depths recorded by the Vemco minilogger during the tow. Depth range is the difference between the deepest and shallowest depth recorded during each tow. Scope was calculated by dividing the amount of tow wire out (m) by the average depth (m) of each tow, and normally fell between 2.5 and 3.4 m. Tow time (h) is the duration of each tow, speed (km/h) is distance traveled divided by the duration of each tow, and distance (km) was calculated using the beginning and ending positions of each tow as defined after comparing the Vemco minilogger depth record to annotations on the DGPS data. Tow distance was approximately 3.6 to 4.0 km in most cases and tow speed range varied by no more than 10% from 5 km/hr. Swept area (km^2) was calculated by multiplying the average door spread (m) by the distance traveled for each tow (km), and normally fell between 0.24 and 0.33 km^2.

Swath area measures the relative importance of each sampled depth according to its contribution to total distance along the transect set perpendicular to the depth contour. Figure 4 shows an example of how the distance along the transect 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 along the transect 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.

Table 2 lists the total catch, in kilograms, for each species caught on the survey. A line indicates the species whose total catch was greater than 1% of the total catch of all species. Table 3 lists the number of tows and the percentage of the total tows in which each species was caught.

Figures 5a-20a depict, by transect, the swept area catch (kg/km^2) for each species whose total catch was greater than 1% of the total catch of all species, and for selected other commercially-important species: Atlantic mackerel, butterfish, scup, and tilefish. Figures 5b-20b depict, by transect, the projected catch of each species for a distance along the transect represented by each tow swath. Figure 21 is the catch/km^2 for all species caught in each transect. Figures 22a-28a represent the cumulative size-frequency distributions obtained by first normalizing each tows data to swept area and then summing across all tows in each transect. Figures 22b-28b show the cumulative size-frequency distributions, corrected first to swept area as before, but then normalized to swath distance along the transect, and finally summed across all tows in each transect. Figures 29-34 are the cumulative size-

frequencies, by tow, for each measured species with greater than 20 individuals measured per tow. Figures 35-41 show the relationship between length and weight per species by tow for each transect.

Acknowledgements

We would like to thank the members of the supplemental survey planning group: Russell Brown, Mark Terciero, Jimmy Ruhle, Phil Ruhle, Jimmy Harris, and Hank Lackner. We would also like to extend our thanks to the NMFS survey branch, the NMFS personnel who participated as science crew aboard the *F/V Jason & Danielle*, Larry Brady and Matt Terwilliger, the captains and crew of the *F/V Jason & Danielle*, and the Rutgers science crew: Kathryn Alcox, Allison Bonner, Jennifer Daetsch, and Bruce Muller. We thank the MAFMC/NMFS for providing funding for this project to NFI (National Fisheries Institute)-Scientific Monitoring Committee through the Research Set-Aside Program. Thanks also to Danny Cohen and Sima Frierman (NFI-SMC) for logistical support.

Table 1. Results of data recorded for each tow. Transect 1 = Hudson Canyon Transect; Transect 2= Baltimore Canyon Transect. Target depth represents the depths at which the fixed positions were chosen before the cruise. Tow depth represents the actual depth. at which each tow was made, calculated as the average of the depths recorded every minute during the tow

Transect	Tow	Date	Tow Begin Time (Military)	Target Depth m	Tow Depth m	Depth Range m	Scope m	Swept Area km2	Swath Area km2	Bottom Temperature F	Tow Time h	Tow Speed km/h	Tow Distance km
1	1	3/8/03	10:41	411.48	391.86	74.90	2.45	0.31	34.37	44.65	0.77	5.01	3.85
1	2	3/8/03	13:12	365.76	347.89	26.00	2.63	0.32	195.36	45.53	0.77	4.97	3.81
1	3	3/8/03	15:22	274.32	267.07	35.80	2.40	0.27	113.92	50.45	0.72	5.32	3.81
1	4	3/8/03	17:18	228.60	219.72	26.00	2.71	0.29	146.93	51.68	0.77	5.13	3.94
1	5	3/8/03	19:23	182.88	177.13	13.00	3.10	0.29	281.70	52.21	0.75	5.16	3.87
1	6	3/8/03	20:57	146.30	141.82	13.00	3.22	0.29	284.83	48.23	0.77	5.20	3.98
1	7	3/8/03	22:40	109.73	103.85	3.20	3.08	0.25	261.31	42.86	0.73	5.47	4.01
1	8	3/9/03	00:14	91.44	84.84	9.70	3.23	0.22	105.35	41.30	0.72	5.14	3.68
2	9	3/9/03	17:00	274.32	275.14	58.60	2.16	0.12	1.92	48.08	0.38	4.75	1.82
2	10	3/9/03	18:20	411.48	421.28	117.30	2.39	0.17	2.85	44.55	0.45	5.34	2.40
2	11	3/9/03	19:32	228.60	219.78	29.30	2.70	0.28	16.02	46.96	0.73	5.40	3.96
2	12	3/9/03	21:13	182.88	173.95	26.10	2.89	0.25	42.76	47.49	0.70	5.26	3.68
2	13	3/9/03	23:04	146.30	142.45	6.50	3.21	0.26	117.10	46.77	0.72	5.27	3.78
2	14	3/9/03	01:36	109.73	104.65	6.50	3.06	0.27	248.99	45.12	0.83	5.28	4.40
2	15	3/9/03	03:53	91.44	87.91	6.50	3.12	0.21	49.75	46.34	0.70	5.22	3.65
2	16	3/10/03	06:49	365.76	337.71	97.70	2.44	0.29	28.90	47.04	0.77	5.24	4.02
2	17	3/10/03	09:20	204.83	200.18	19.50	2.97	0.27	45.02	47.43	0.72	5.30	3.80
2	18	3/10/03	11:44	320.04	279.52	61.90	2.62	0.30	20.76	48.38	0.82	5.14	4.20
2	19	3/10/03	13:54	128.02	124.08	3.20	3.32	0.25	256.55	47.23	0.72	5.23	3.75
2	20	3/10/03	16:53	100.58	96.70	3.20	3.31	0.24	167.71	46.16	0.72	5.22	3.74
1	21	3/11/03	06:15	457.20	458.18	87.90	2.20	0.29	18.26	42.56	0.73	5.29	3.88
1	22	3/11/03	07:47	387.71	382.67	13.00	2.51	0.33	40.84	44.25	0.82	4.94	4.04
1	23	3/11/03	09:36	250.55	244.57	9.80	2.43	0.23	14.42	49.51	0.70	5.16	3.62
1	24	3/11/03	11:33	128.02	123.65	3.30	3.33	0.26	353.33	44.92	0.70	5.23	3.66
1	25	3/11/03	13:15	100.58	95.10	6.50	3.37	0.26	157.71	41.32	0.77	5.32	4.08

Table 2. Total catch in kg for each species caught during the March 2003 survey. Species above the line represent those species whose total catch was greater than 1% of the total catch of all species.

Species	Total Catch (kg)	Species	Total Catch (kg)
Spiny Dogfish	11183.51	Winter Skate	5.17
Silver Hake/Offshore Hake	1702.83	Unknown Cancer Crab	4.85
Monkfish	1465.31	Grenadier	4.70
Summer Flounder	1397.69	Slender Snipe Eel	4.17
Black Sea Bass	1387.97	Conger Eel	4.15
Loligo Squid	1110.27	Barndoor Skate	3.88
Spotted Hake	847.52	Armored Sea Robin	3.80
Fourspot Flounder	771.77	Marlinspike	3.07
Atlantic Herring	704.92	Flathead Greeneye	2.51
Unknown Anemone	515.75	Unknown Swimmer Crab	2.49
Witch Flounder	474.94	Tricorn Batfish	2.33
Northern Sea Robin	283.59	Black Dogfish	2.33
Red Deepsea Crab	278.62	Redfish	2.25
Alewife	169.03	Gladiator Box Crab	1.97
Chain Dogfish	156.71	Gulfstream Flounder	1.69
Atlantic Mackerel	124.89	Longnose Greeneye	1.42
Butterfish	124.27	Blue Hake	0.78
Jonah Crab	123.99	Sea Scallop	0.64
Red Hake	114.35	Spotfin Dragonet	0.53
Little Skate	104.80	Beardfish	0.45
Blackbelly Rosefish	94.25	Unknown Fish	0.43
Rosette Skate	87.35	Singlespot Frogfish	0.36
Hickory Shad	77.52	Northern kingfish	0.34
Thorny Skate	68.06	Atlantic argentine	0.25
Sea Potato	67.39	Octopus	0.22
Striped Sea Robin	60.15	Fawn Cusk Eel	0.16
Tilefish	58.48	Keelcheek Bass	0.16
White Hake	57.58	Blackmouth Bass	0.14
American Lobster	50.86	Lizardfish	0.14
Clear Nosed Skate	30.57	Mantis Shrimp	0.11
Longfin Hake	29.96	Atlantic Cutlass Fish	0.09
Rock Crab	21.21	Duckbill Flathead	0.09
Weakfish	20.38	Snake Mackerel	0.07
Starfish	19.15	Lancetfish	0.05
Scup	15.79	Fourbeard Rockling	0.05
John Dory	15.44	Hermit Crab	0.05
Unknown Shrimp	14.84	Shortnose Greeneye	0.05
Deepbody Boarfish	14.82	Unknown Sand Worms	0.01
Illex Squid	9.25	Ocean Quahog	0.00
Smooth Skate	8.32		
Blueback Herring	7.21		
Unknown Spider Crab	5.86		
Unknown Speckled Crab	5.76		
Smooth Dogfish	5.17		

Table 3. Number and percentage of tows in which each species was caught.

Species	# Times Caught	Percentage
Loligo Squid	25	100
Silver Hake/Offshore Hake	24	96
Spiny Dogfish	24	96
Monkfish	24	96
Jonah Crab	23	92
Witch Flounder	22	88
Spotted Hake	22	88
Chain Dogfish	21	84
Fourspot Flounder	21	84
Illex Squid	18	72
Rosette Skate	17	68
Blackbelly Rosefish	16	64
Butterfish	16	64
Atlantic Mackerel	15	60
Summer Flounder	15	60
Black Sea Bass	13	52
Unknown Anemone	12	48
Unknown Shrimp	12	48
Alewife	12	48
Red Hake	12	48
Red Deepsea Crab	11	44
American Lobster	11	44
Scup	11	44
Sea Potato	10	40
Armored Sea Robin	10	40
Slender Snipe Eel	10	40
Unknown Spider Crab	10	40
Clearnose Skate	9	36
John Dory	9	36
Rock Crab	9	36
White Hake	8	32
Hickory Shad	8	32
Tricorn Batfish	8	32
Gulfstream Flounder	8	32
Gladiator Box Crab	8	32
Atlantic Herring	8	32
Beardfish	8	32
Tilefish	8	32
Northern Sea Robin	8	32
Black Dogfish	7	28
Little Skate	7	28
Starfish	7	28
Marlinspike	7	28
Longfin Hake	6	24
Unknown Cancer Crab	6	24
Blueback Herring	6	24
Thorny Skate	5	20
Smooth Skate	5	20
Atlantic Argentine	5	20
Striped Sea Robin	5	20
Deepbody Boarfish	5	20
Smooth Dogfish	4	16
Weakfish	4	16
Conger Eel	4	16
Blue Hake	4	16
Unknown Swimmer Crab	4	16
Unknown Grenadier	3	12
Spotfin Dragonet	3	12
Sea Scallop	3	12
Northern Kingfish	3	12
Redfish	2	8
Mantis Shrimp	2	8
Barndoor Skate	2	8
Atlantic Cutlassfish	2	8
Duckbill Flathead	2	8
Longnose Greeneye	2	8
Flathead Greeneye	2	8
Lancetfish	1	4
Octopus	1	4
Fourbeard Rockling	1	4
Snake Mackerel	1	4
Blackmouth Bass	1	4
Hermit Crab	1	4
Unknown Sand Worms	1	4
Ocean Quahog	1	4
Fawn Cusk Eel	1	4
Lizardfish	1	4
Unknown Speckled Crab	1	4
Unknown Fish	1	4
Keelcheek Bass	1	4
Shortnose Greeneye	1	4
Singlespot Frogfish	1	4
Winter Skate	1	4

Figure 1. Location of tows made along the Hudson Canyon Transect in March 2003. Fixed tows are marked with triangles as the tow begin point and circles as the tow end point. Adaptive tows are marked with stars as the beginning and ending points. The filled circle at the top of the transect represents the approximate location of the 40 fm tow that will become a fixed station during the May 2003 survey.

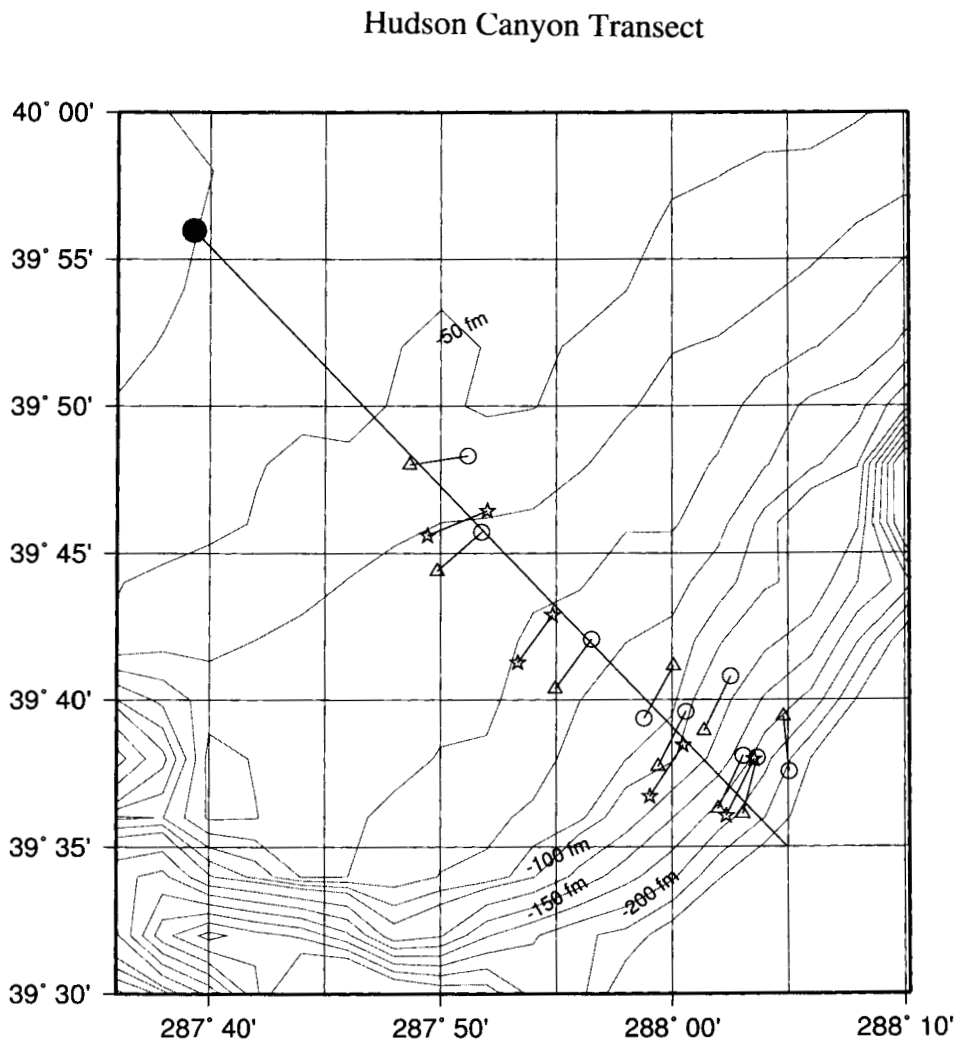


Figure 2. Location of tows made along the Baltimore Canyon Transct in March 2003. Fixed tows are marked with triangles as the tow begin point and circles as the tow end point. Adaptive tows are marked with stars as the beginning and ending points. The filled circle located near the top of the transect represents the approximate location of the 40 fm tow that will become a fixed station during the May 2003 survey. Tows with filled symbols represent tows that will be moved or lengthened during the May 2003 survey.

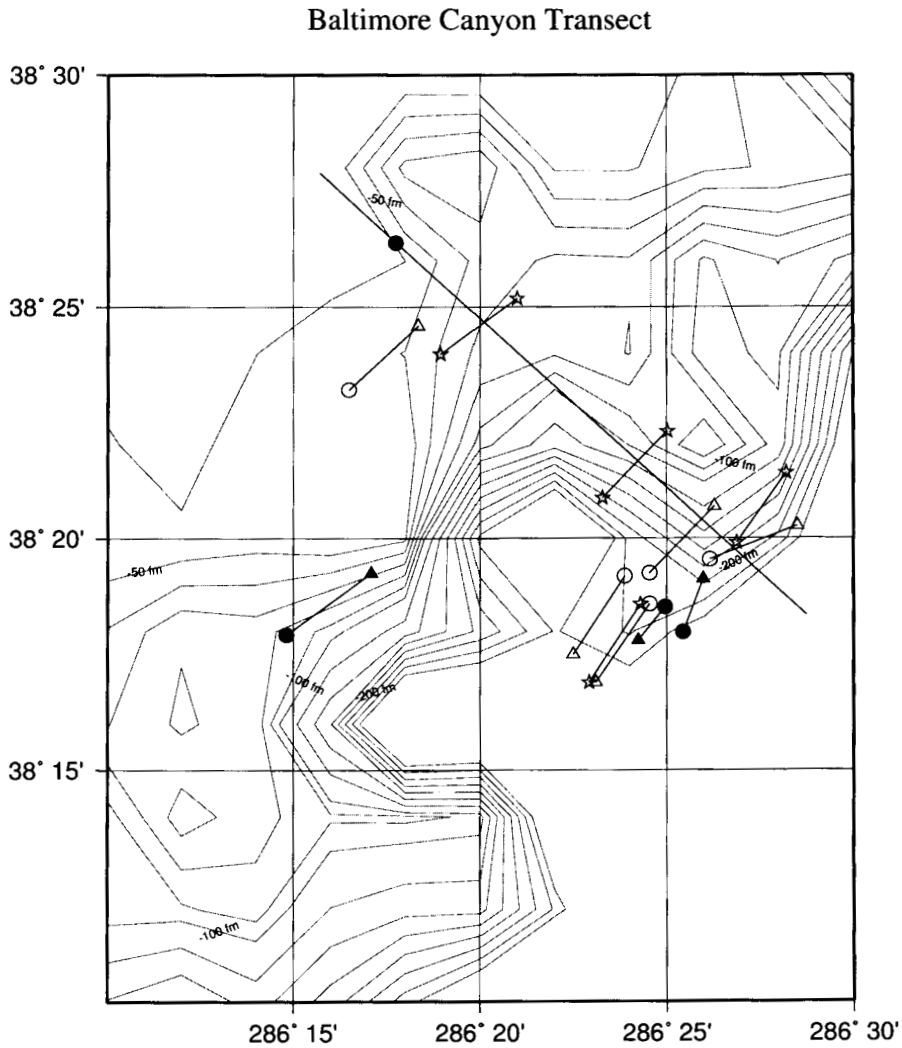


Figure 3. Example of calculations used to select adaptive tows for the survey. The stations are ranked accord
The ranks are summed (Sum column in lower left table). Potential intermediate stations are established between
(upper right table). The four to be sampled are indentified by the four lowest total scores in the Sum column

Catch (kg) in the First 8 Stations of the Transect

Fixed Station	Summer Flounder	Scup	Sea Bass	Monkfish	Dogfish
50	5	14	2	2	10
60	15	34	4	0	50
80	4	11	0	6	23
100	24	35	1	15	250
125	36	0	0	25	45
150	3	2	0	50	127
200	0	0	0	11	31
225	0	0	0	4	0

Rank of Catch by Species

Fixed Station	Summer Flounder	Scup	Sea Bass	Monkfish	Dogfish	Sum
50	4	3	2	7	7	23
60	3	2	1	8	3	17
80	5	4	6	5	6	26
100	2	1	3	3	1	10
125	1	7	6	2	4	20
150	6	5	6	1	2	20
200	7.5	7	6	4	5	29.5
225	7.5	7	6	6	8	34.5

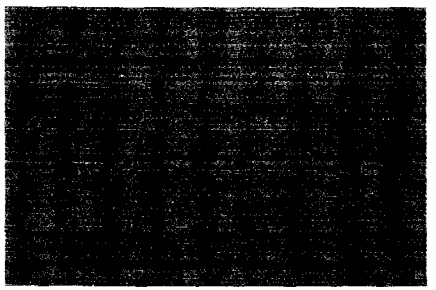


Figure 4. Swath distance for tows 1, 2, and 3, taken near a transect, showing the distance allotted to each tow had it actually been taken alng the transect.

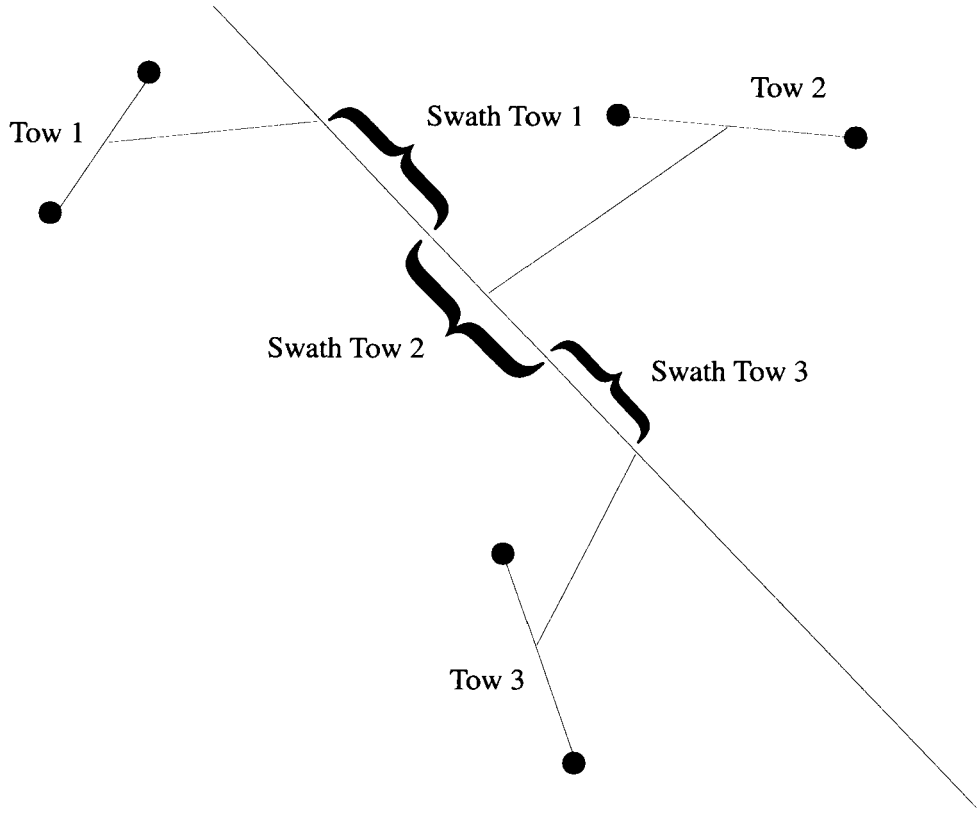


Figure 5a. Catches of Atlantic herring in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

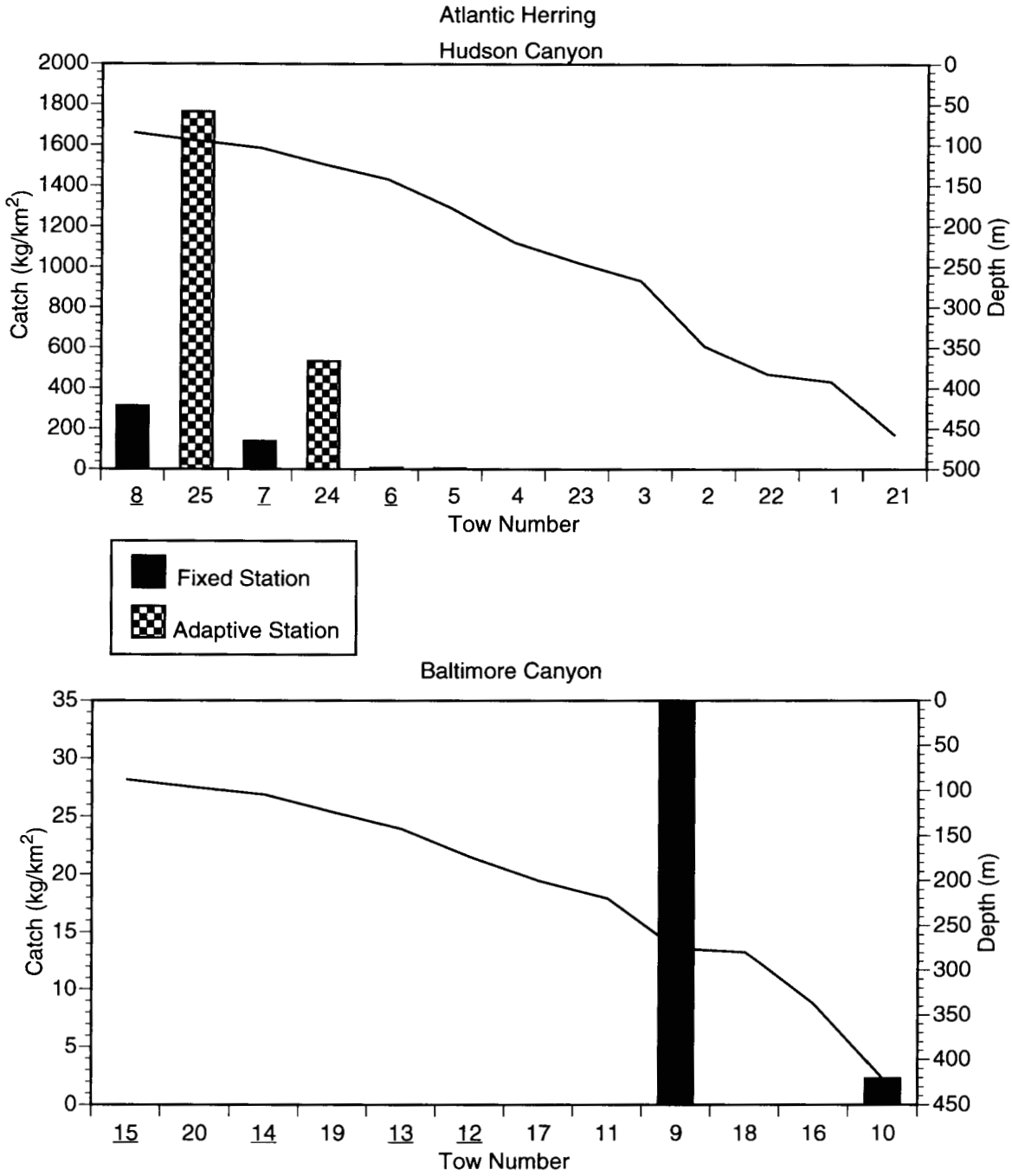


Figure 5b. Projected abundance of Atlantic herring along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

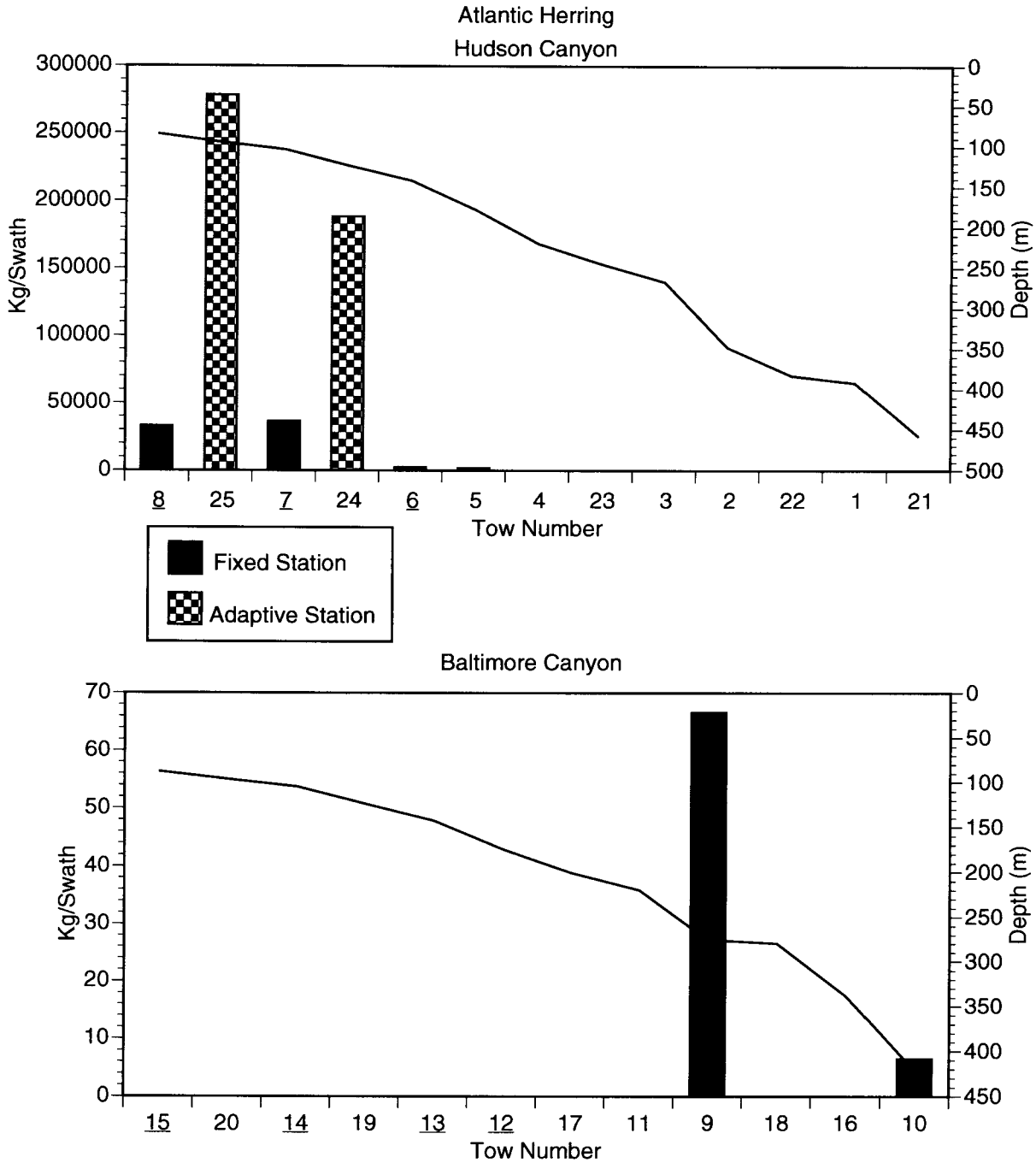


Figure 6a. Catches of Atlantic mackerel in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined to wnumbers indicate tows taken at night (after 8PM).

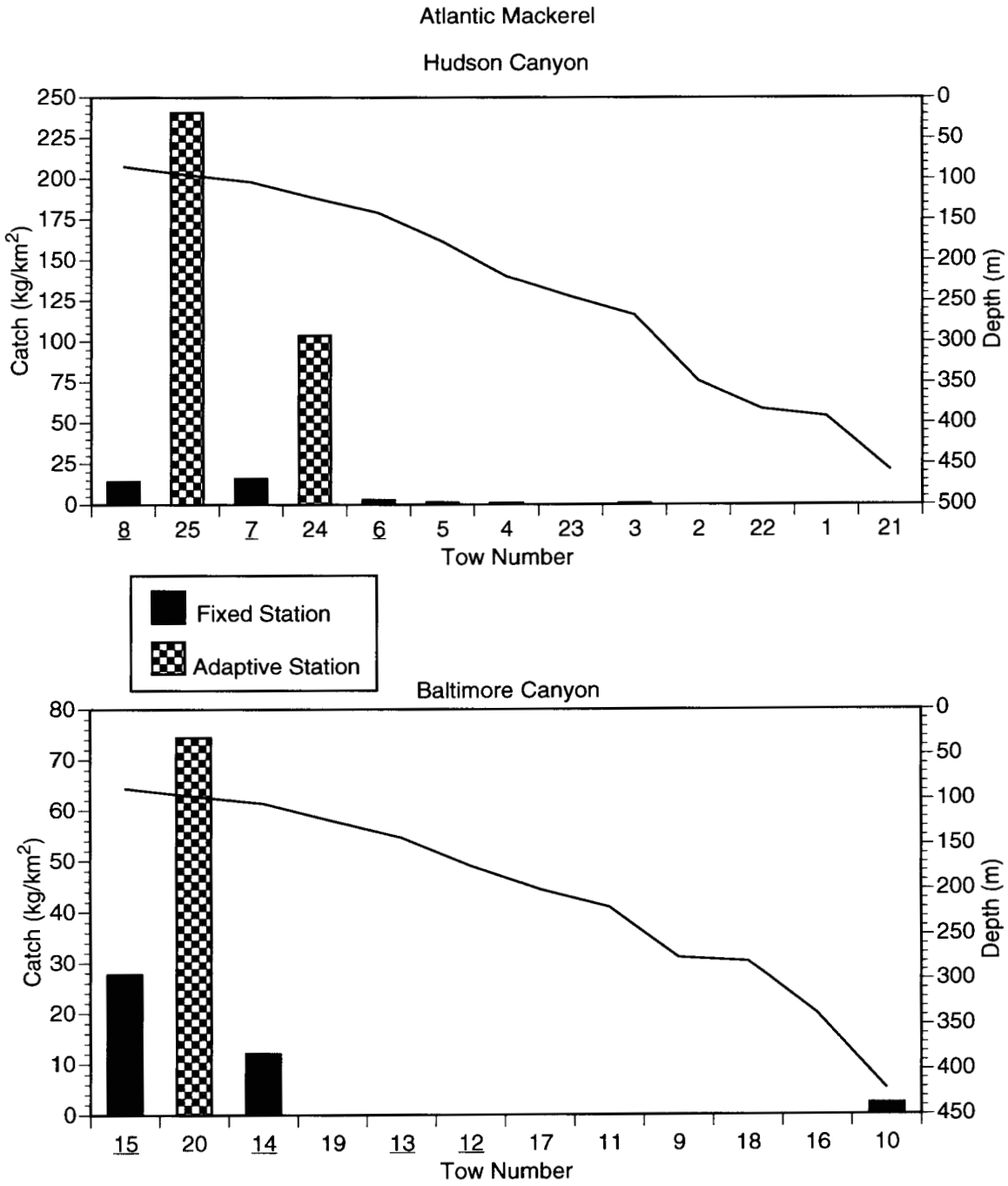


Figure 6b. Projected abundance of Atlantic mackerel along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tows indicate tows taken at night (after 8PM).

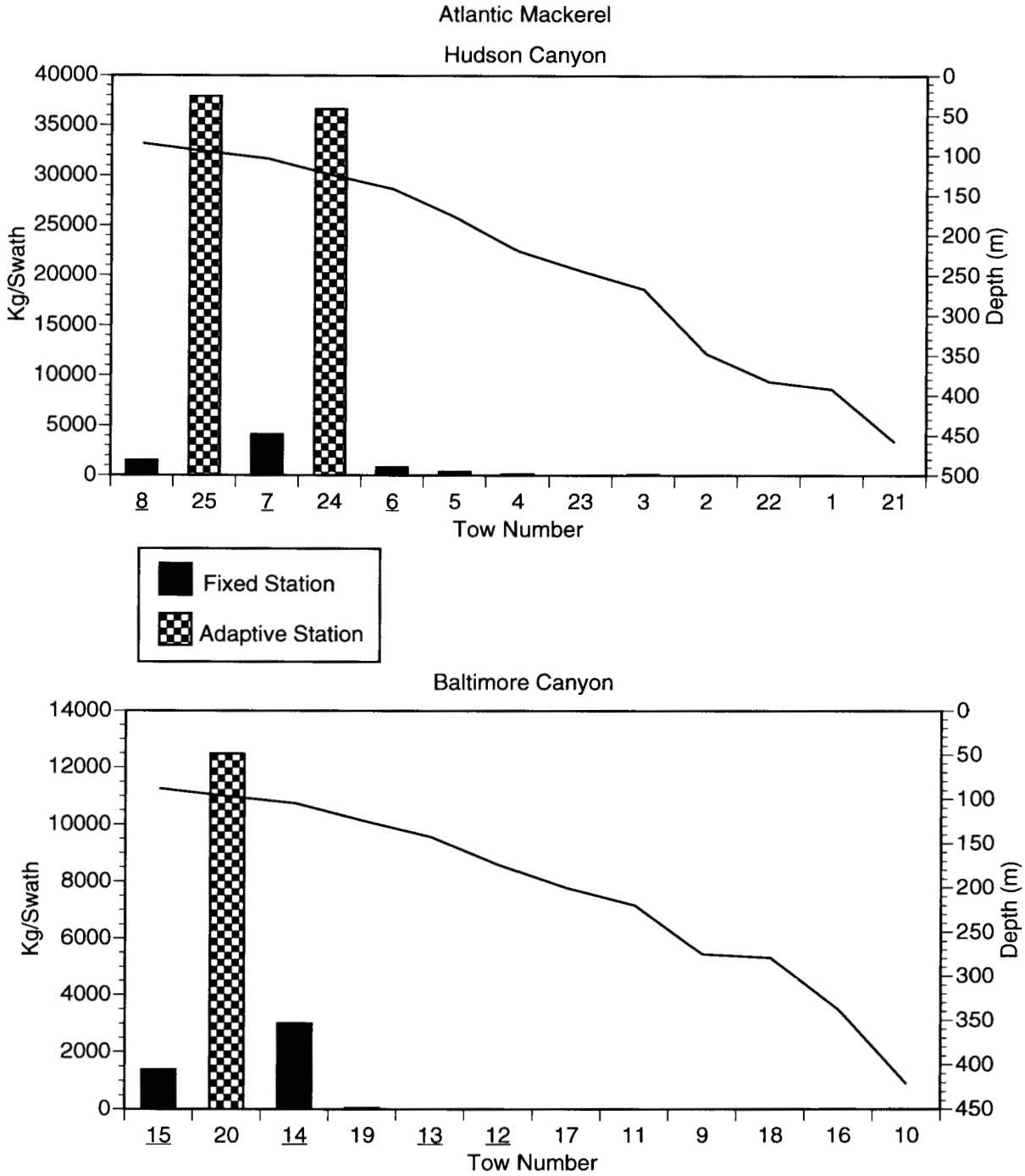


Figure 7a. Catches of black sea bass in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

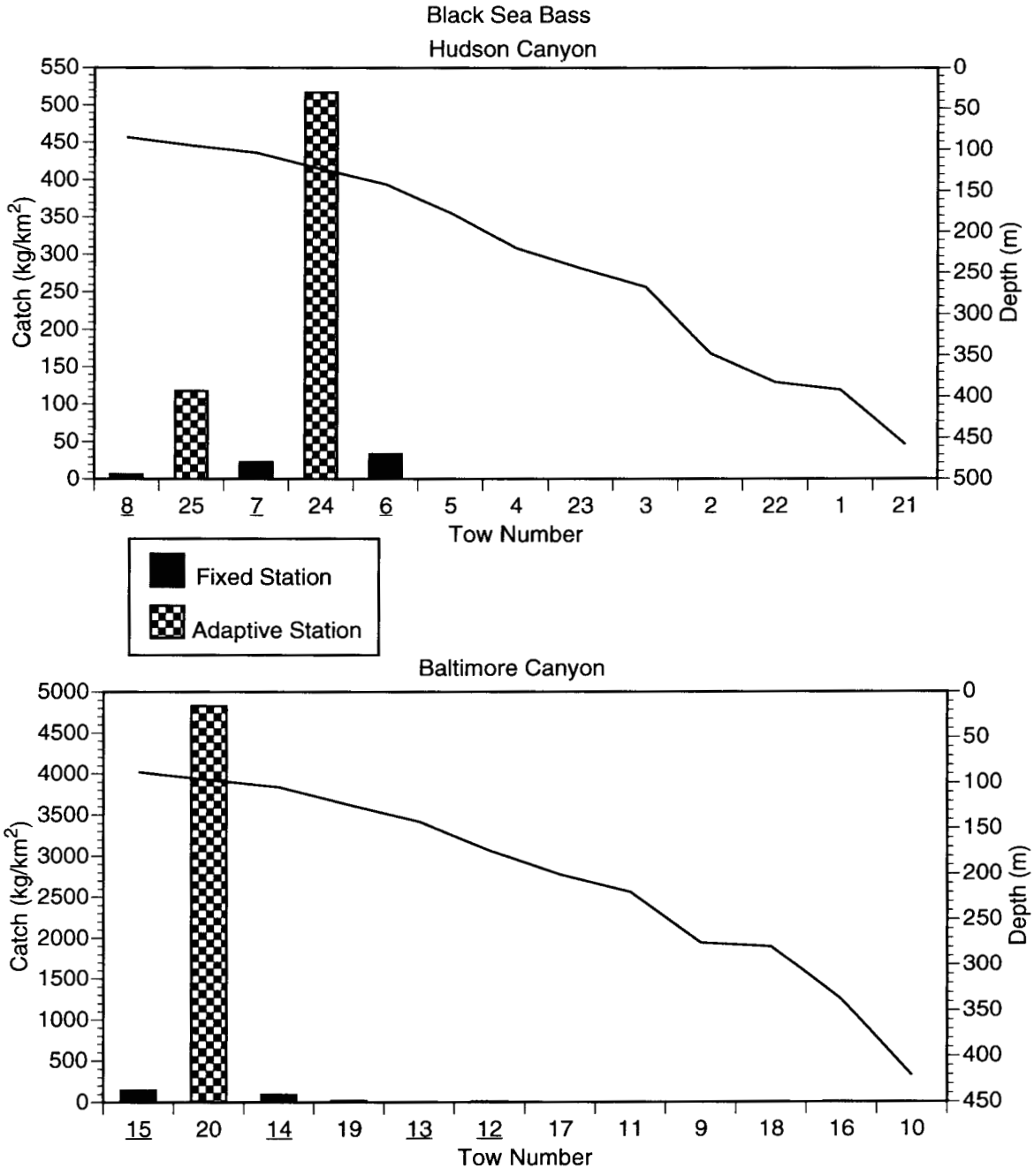


Figure 7b. Projected abundance of black sea bass along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

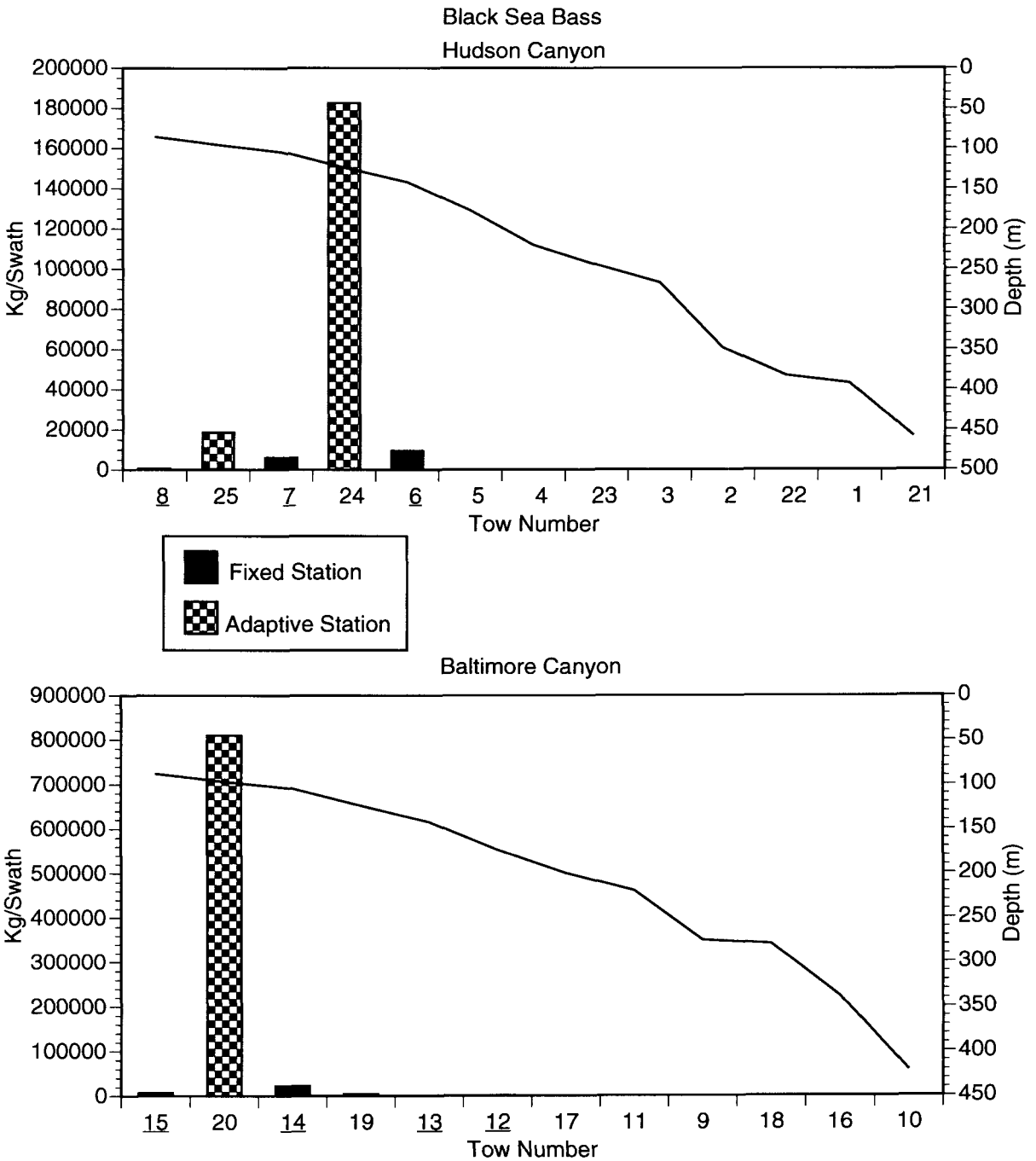


Figure 8a. Catches of butterfish in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

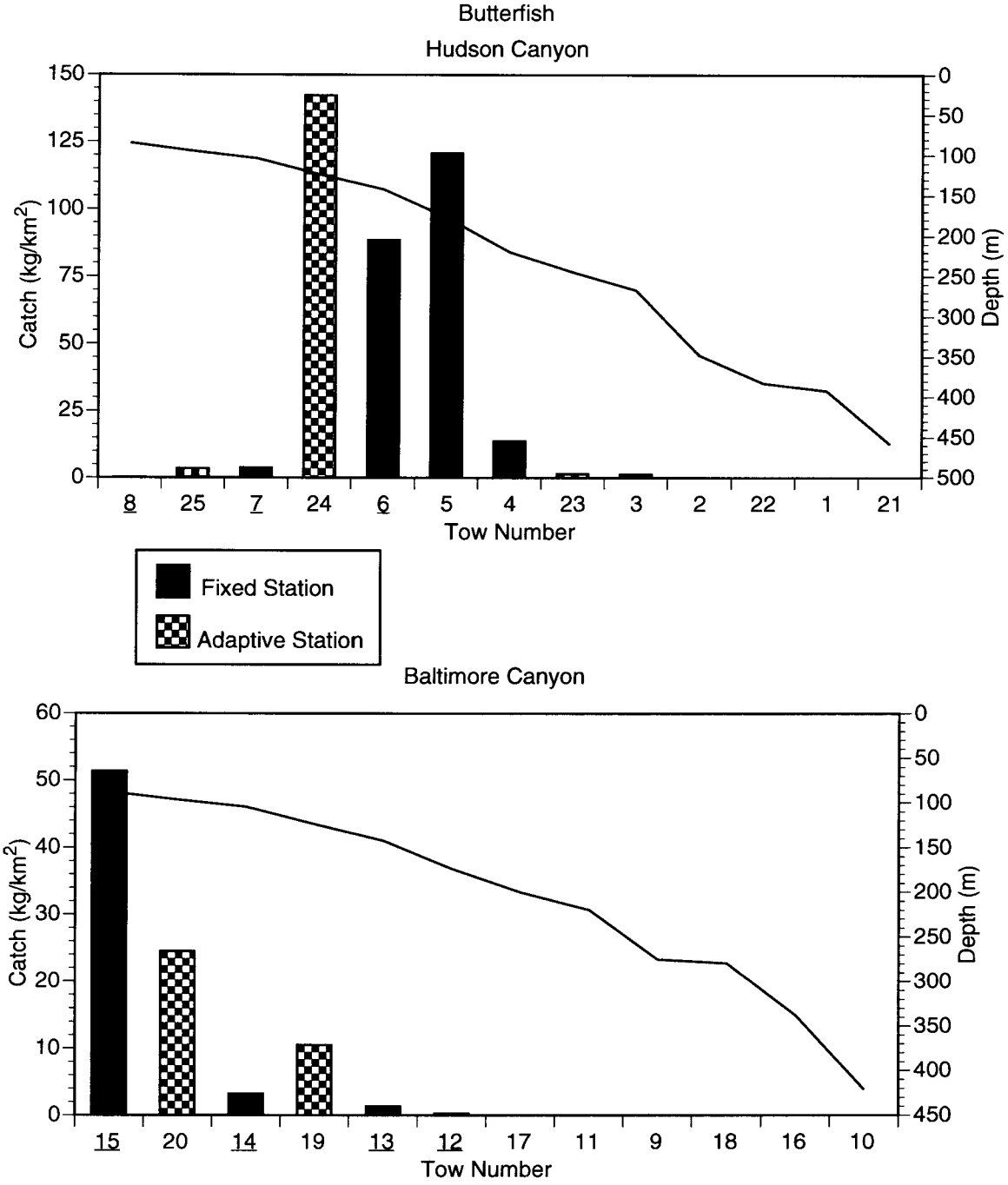
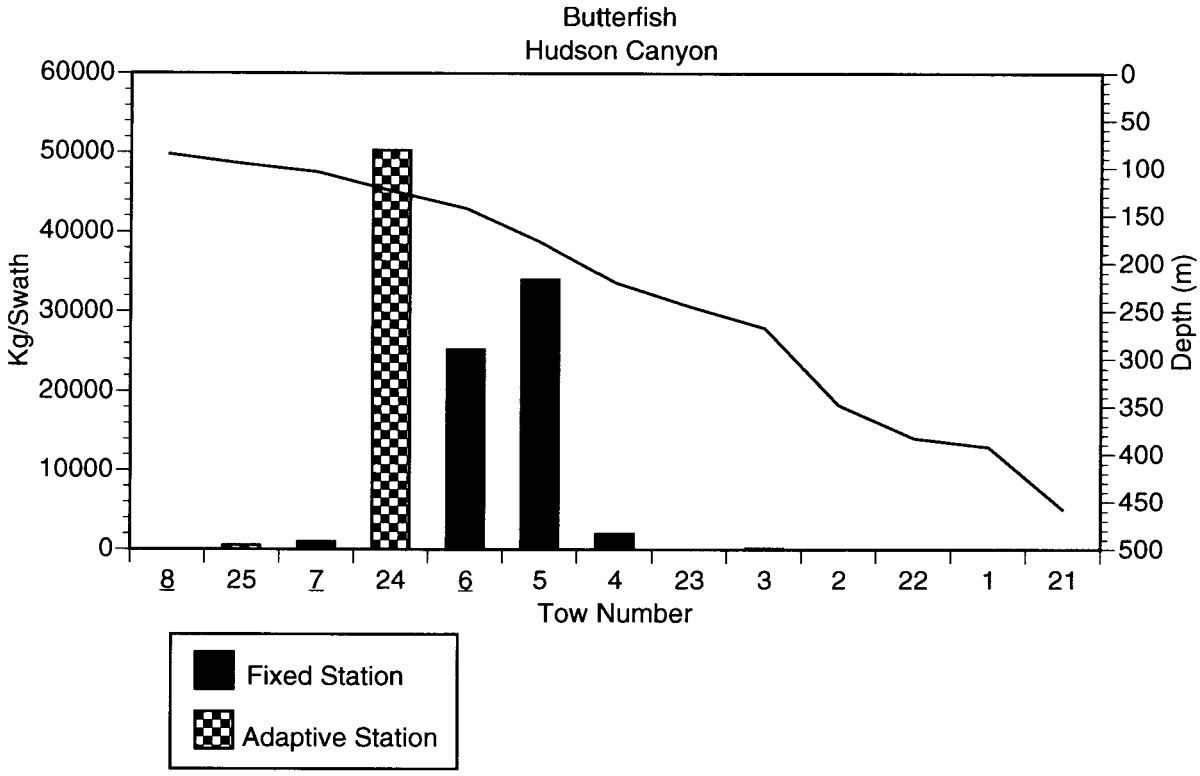


Figure 8b. Projected abundance of butterfish along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).



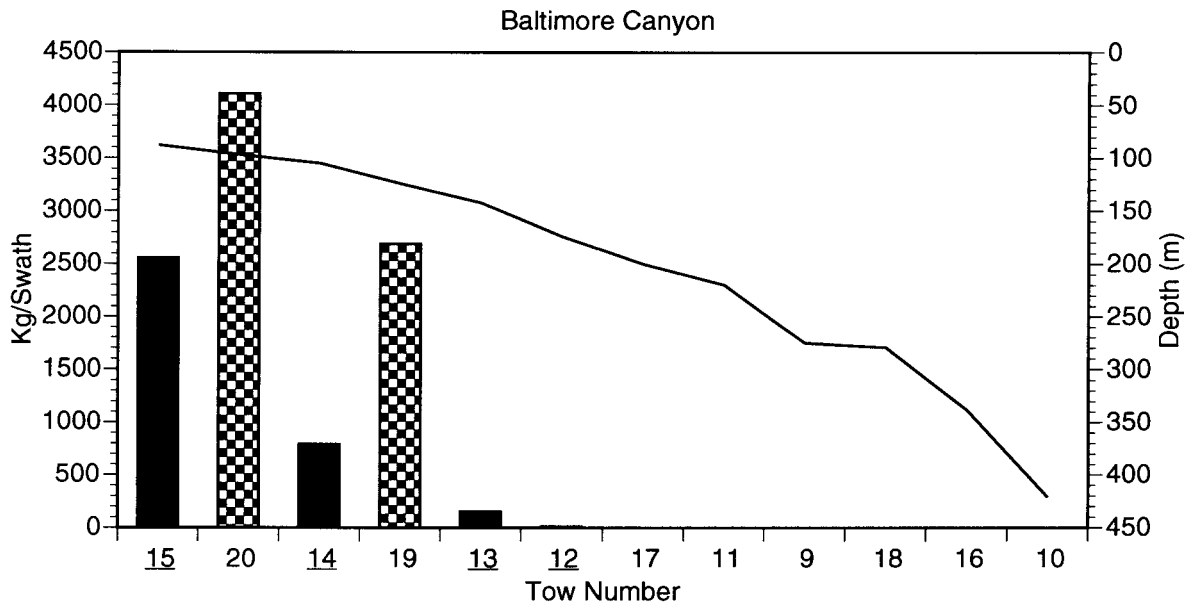


Figure 9a. Catches of deepsea red crab in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

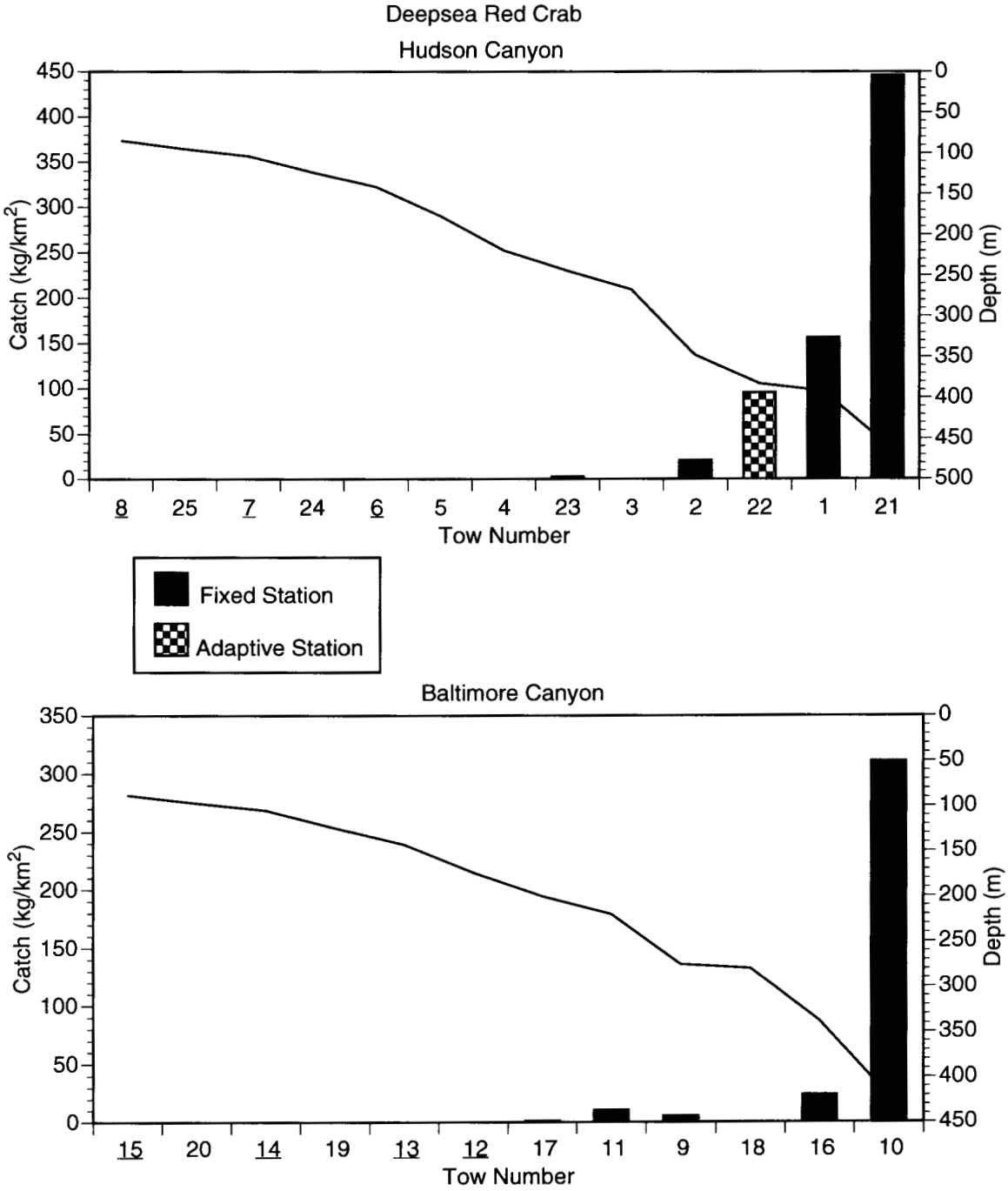


Figure 9b. Projected abundance of deepsea red crab along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

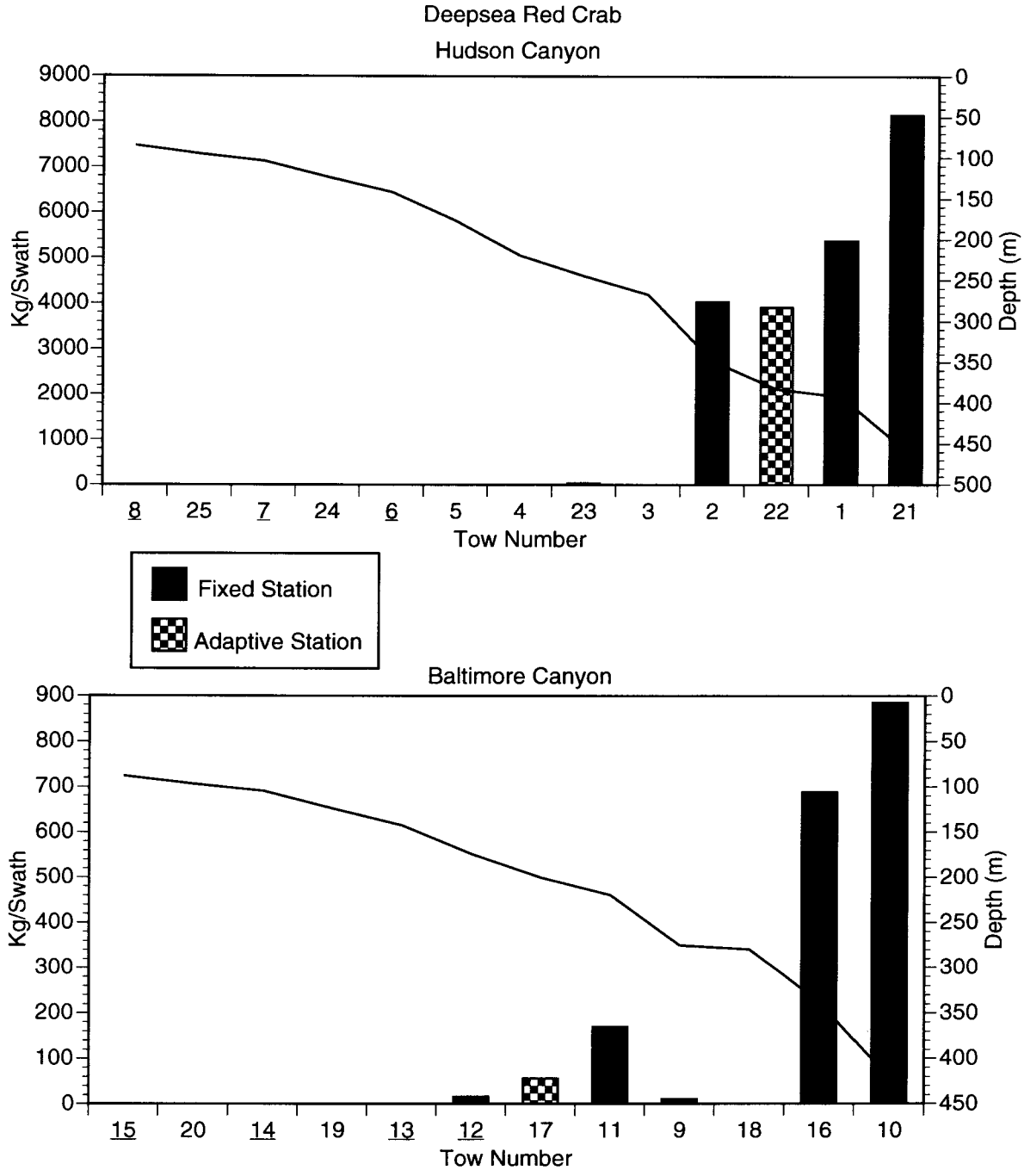


Figure 10a. Catches of fourspot flounder in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined to wnumbers indicate tows taken at night (after 8PM).

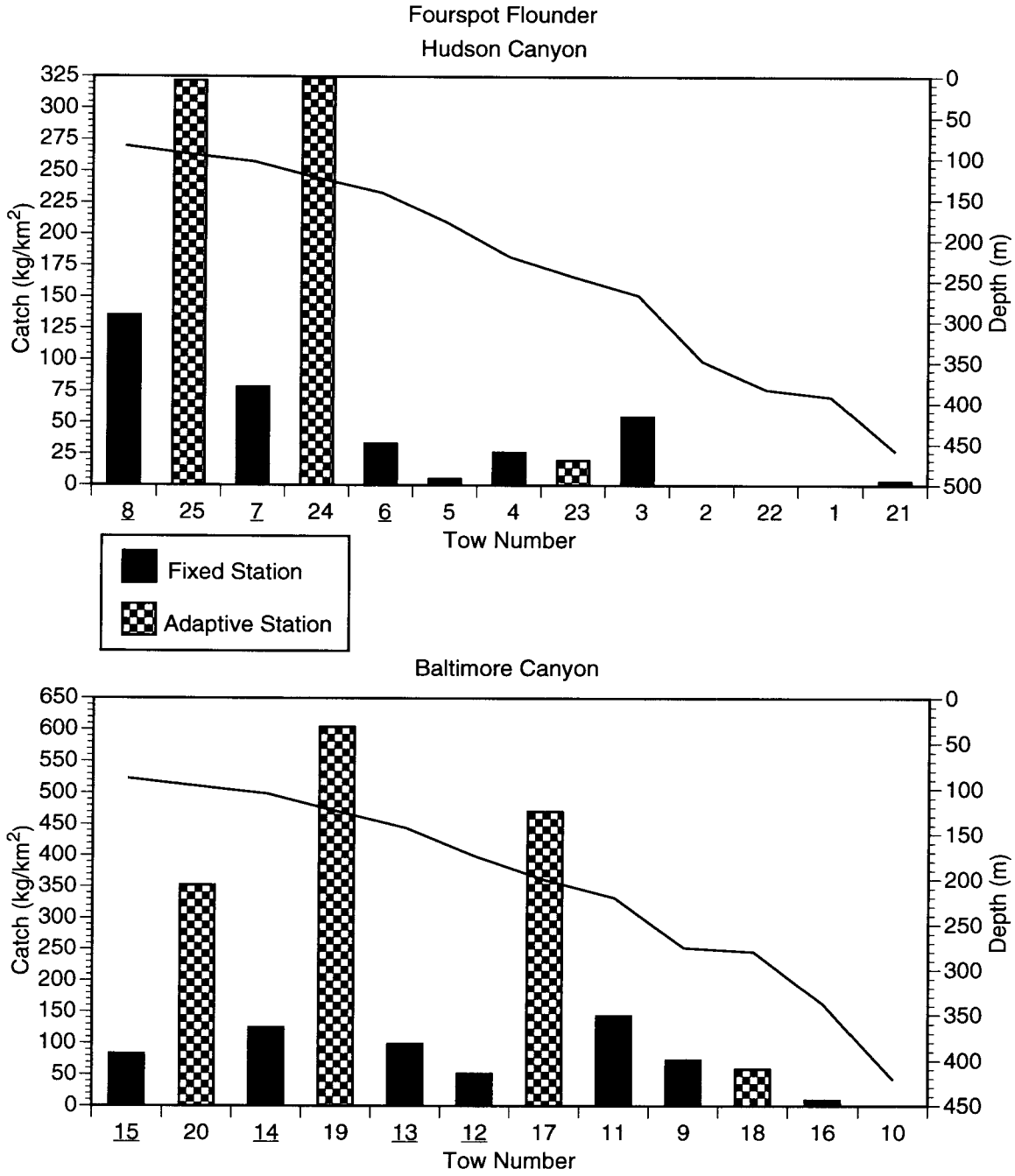


Figure 10b. Projected abundance of fourspot flounder along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

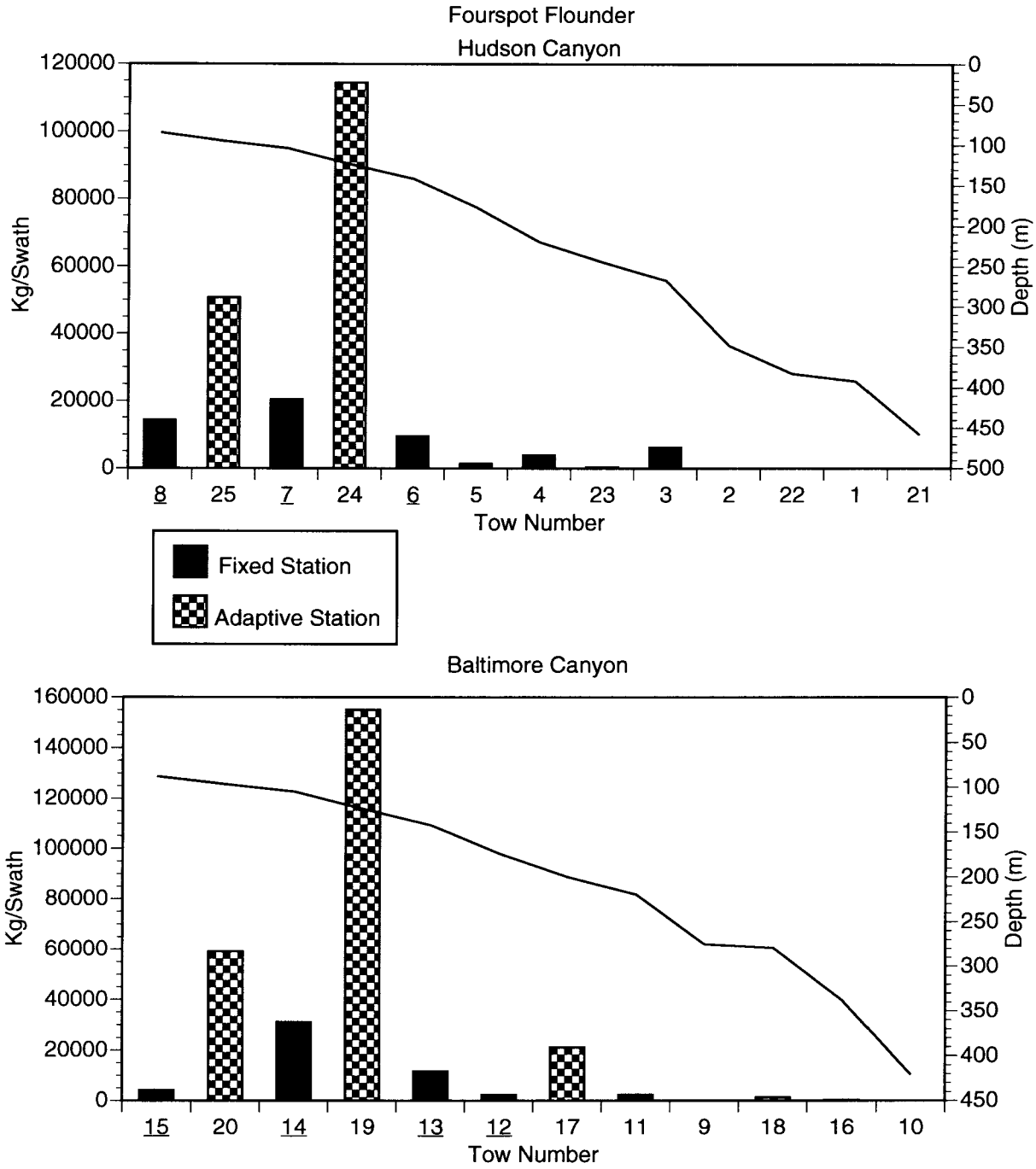


Figure 11a. Catches of *Loligo* squid in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

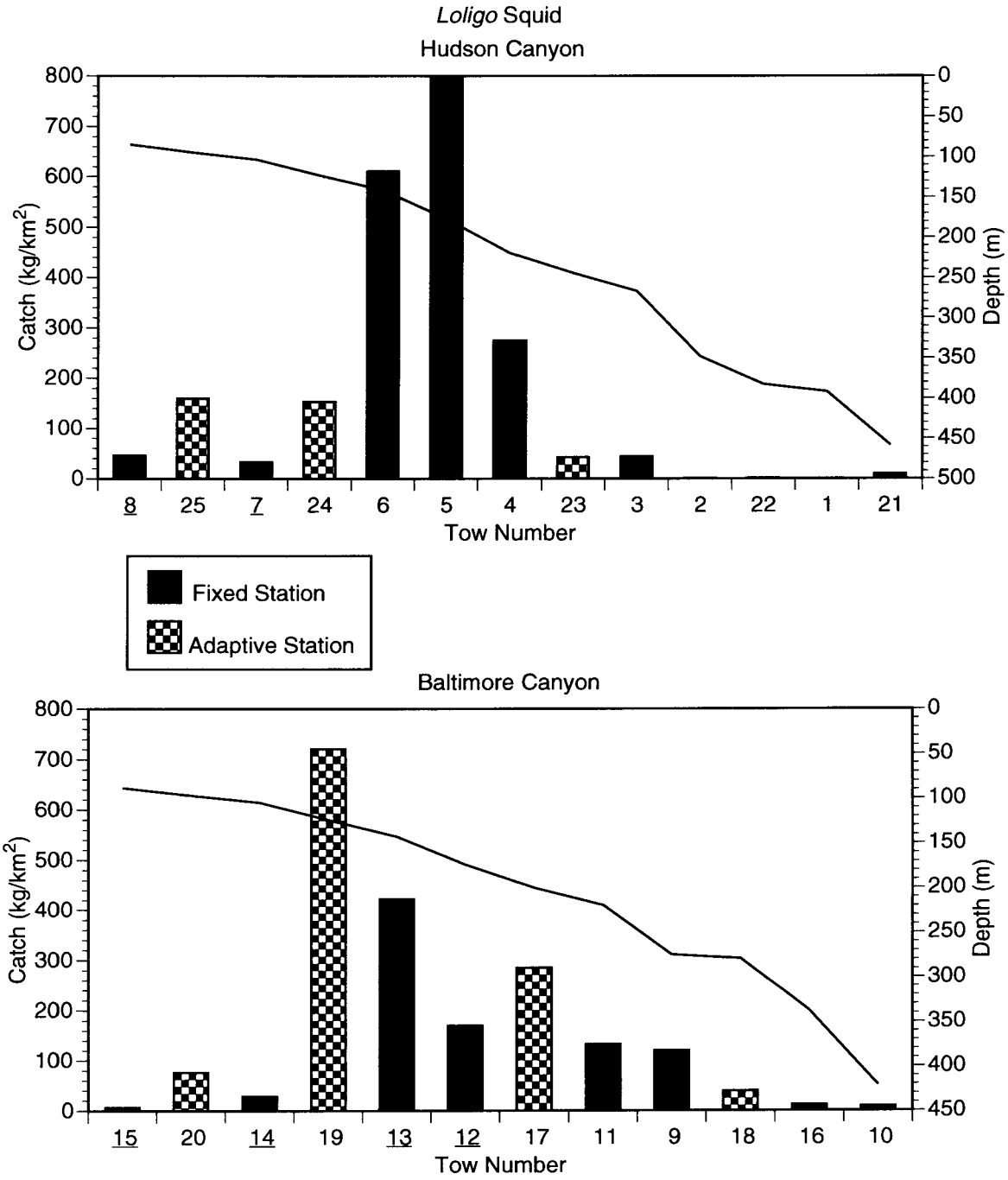


Figure 11b. Projected abundance of *Loligo* squid along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tows indicate tows taken at night (after 8PM).

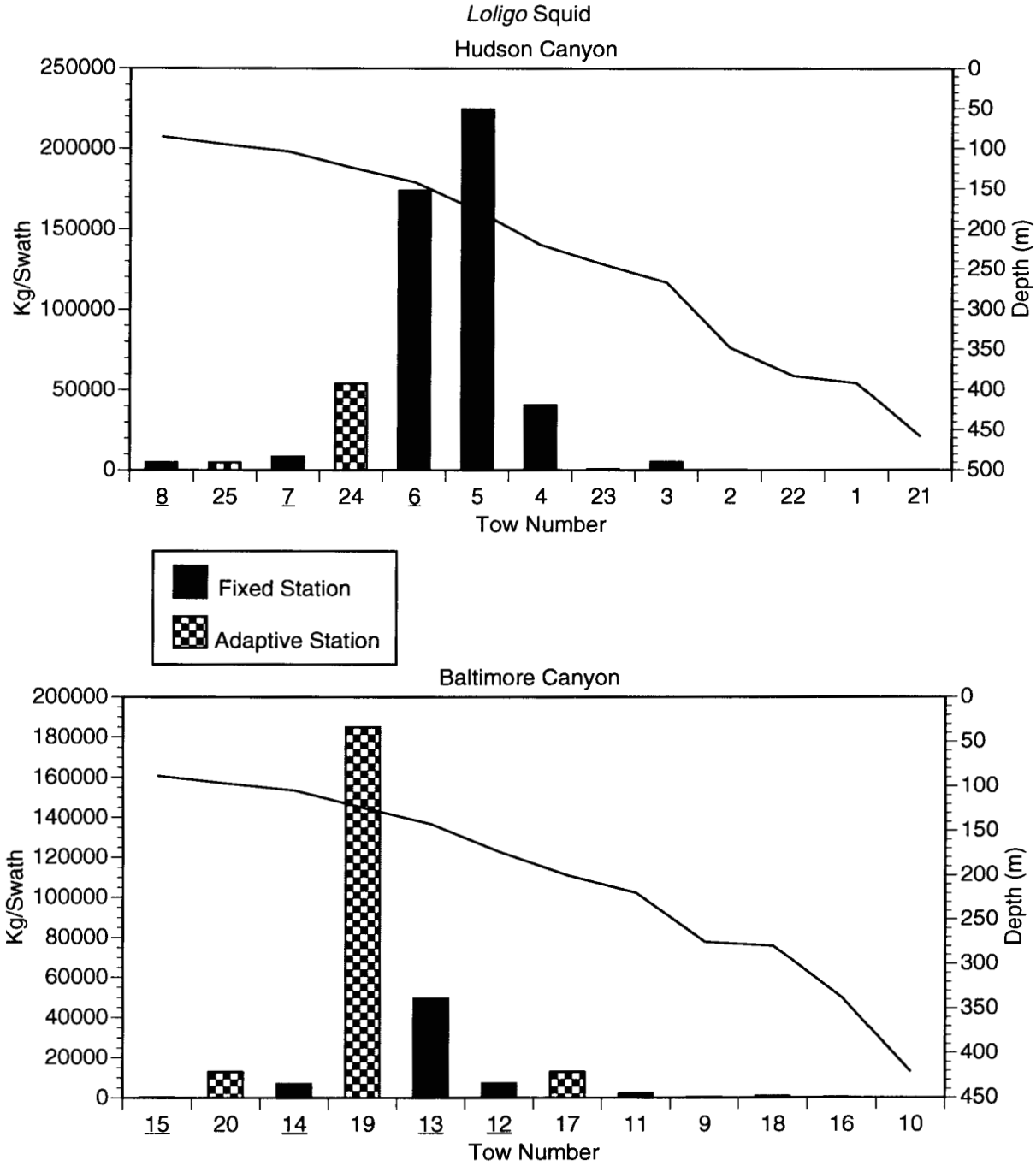


Figure 12a. Catches of monkfish in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is theaverage depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

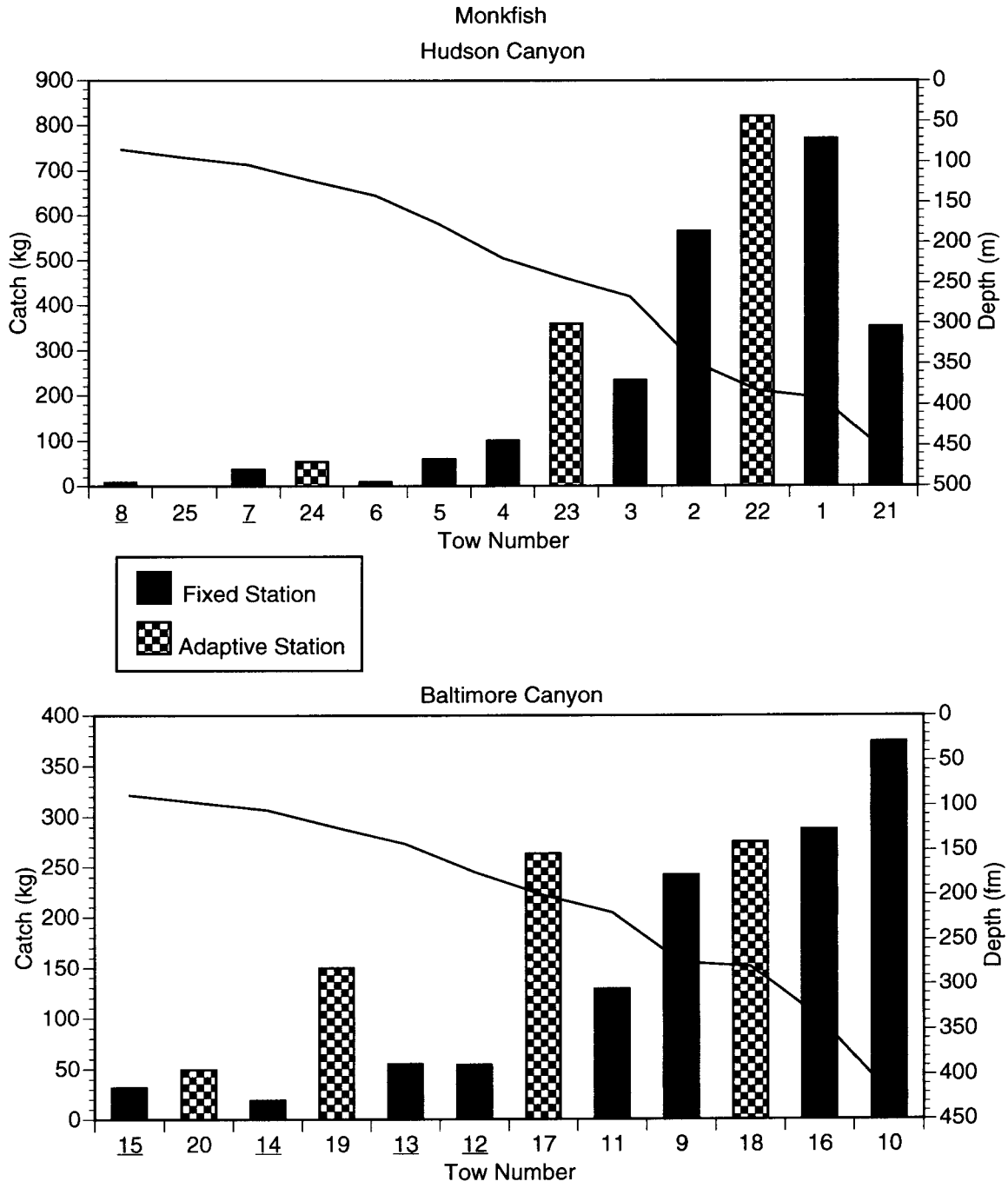


Figure 12b. Projected abundance of monkfish along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

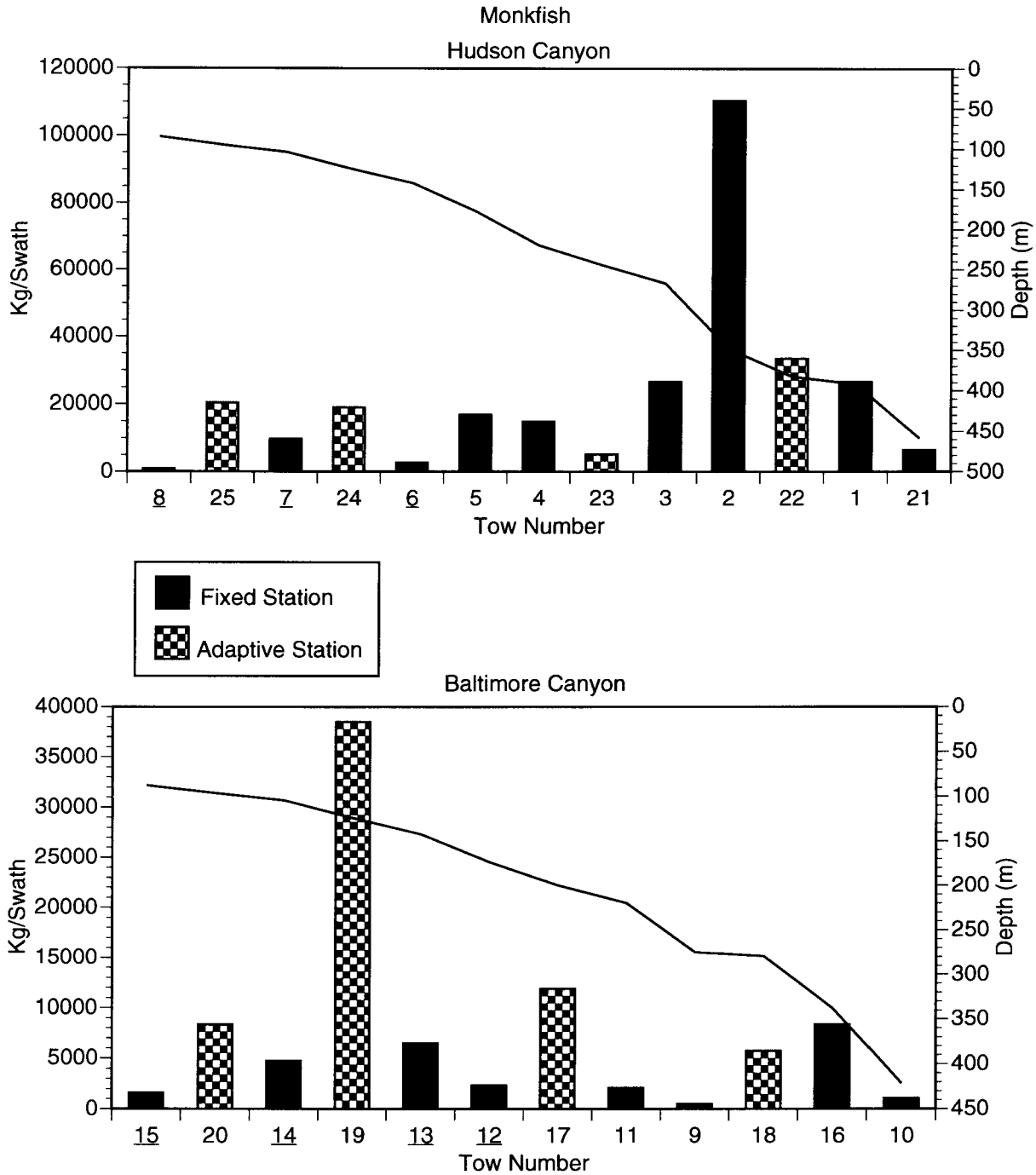


Figure 13a. Catches of northern sea robin in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

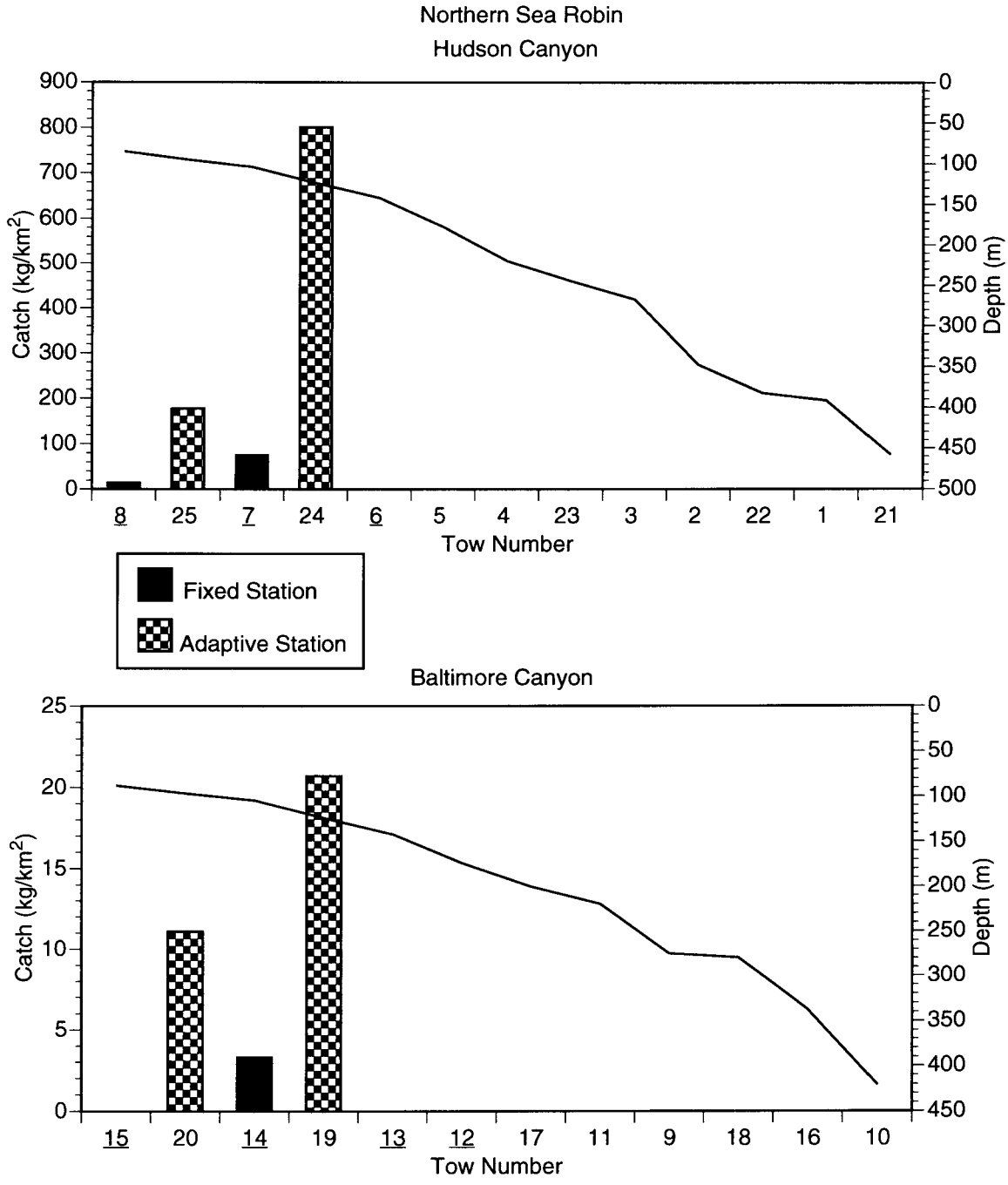


Figure 13b. Projected abundance of northern sea robin along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (8PM).

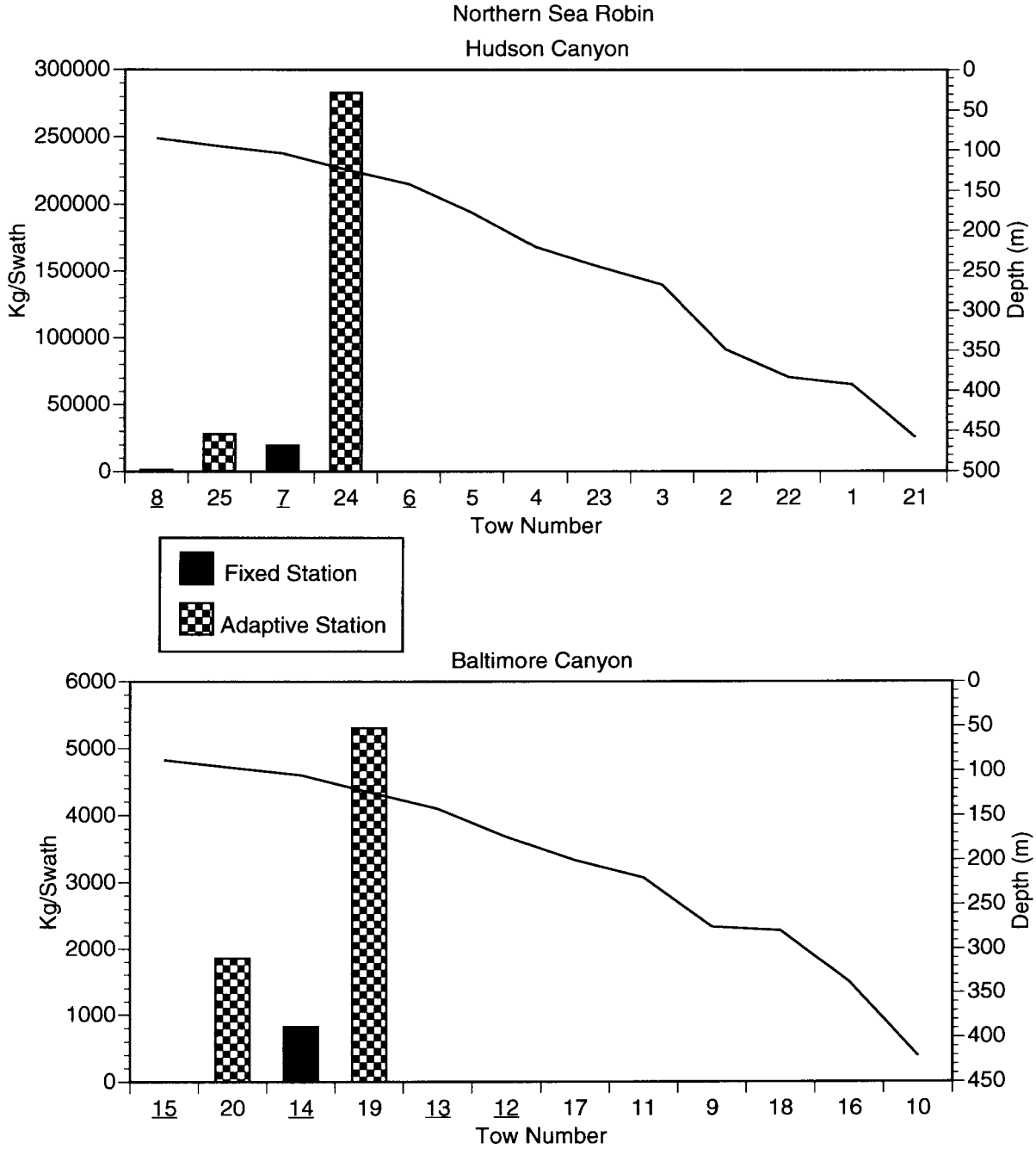


Figure 14a. Catches of scup in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

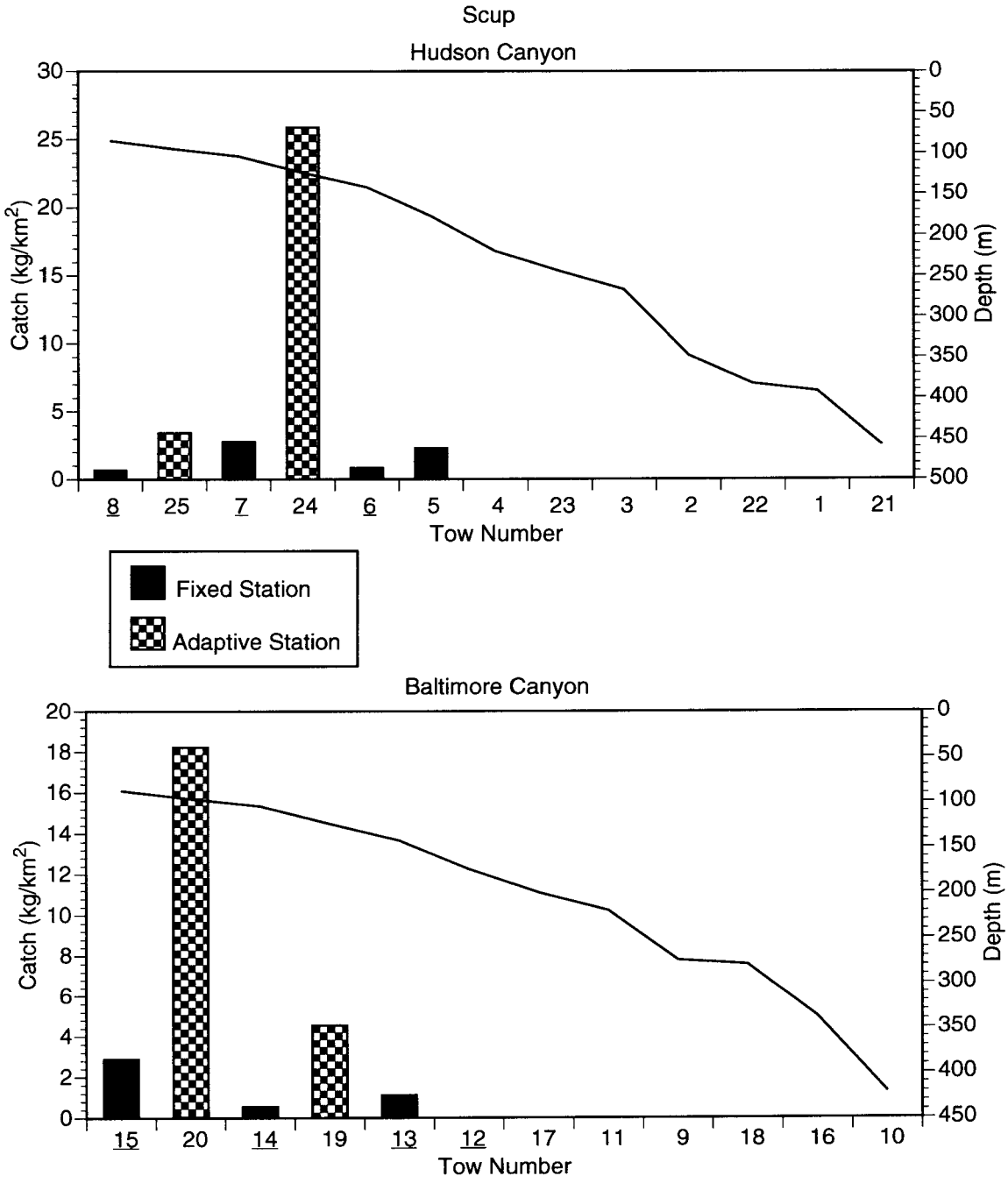


Figure 14b. Projected abundance of scup along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

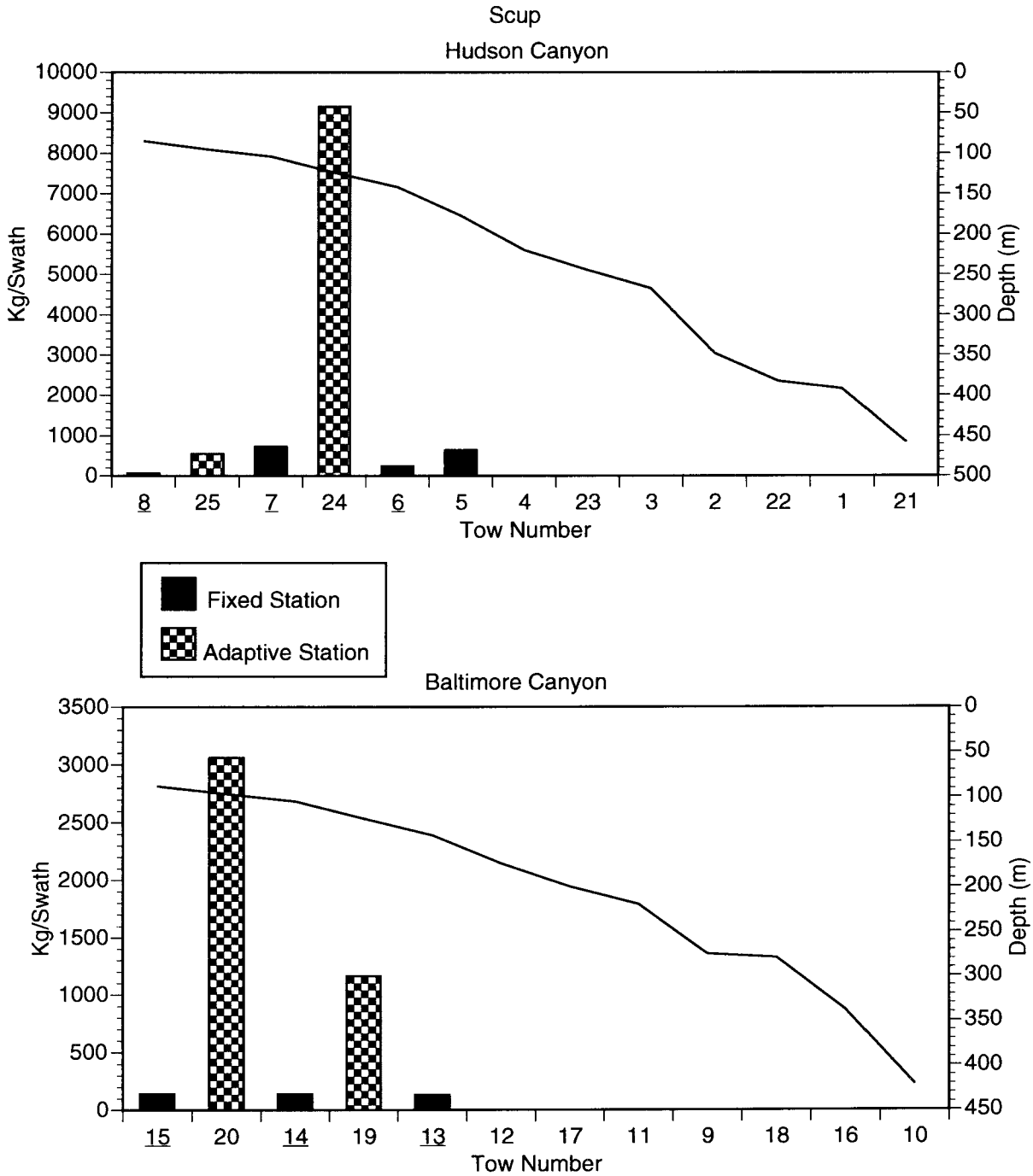


Figure 15a. Catches of silver hake/offshore hake in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

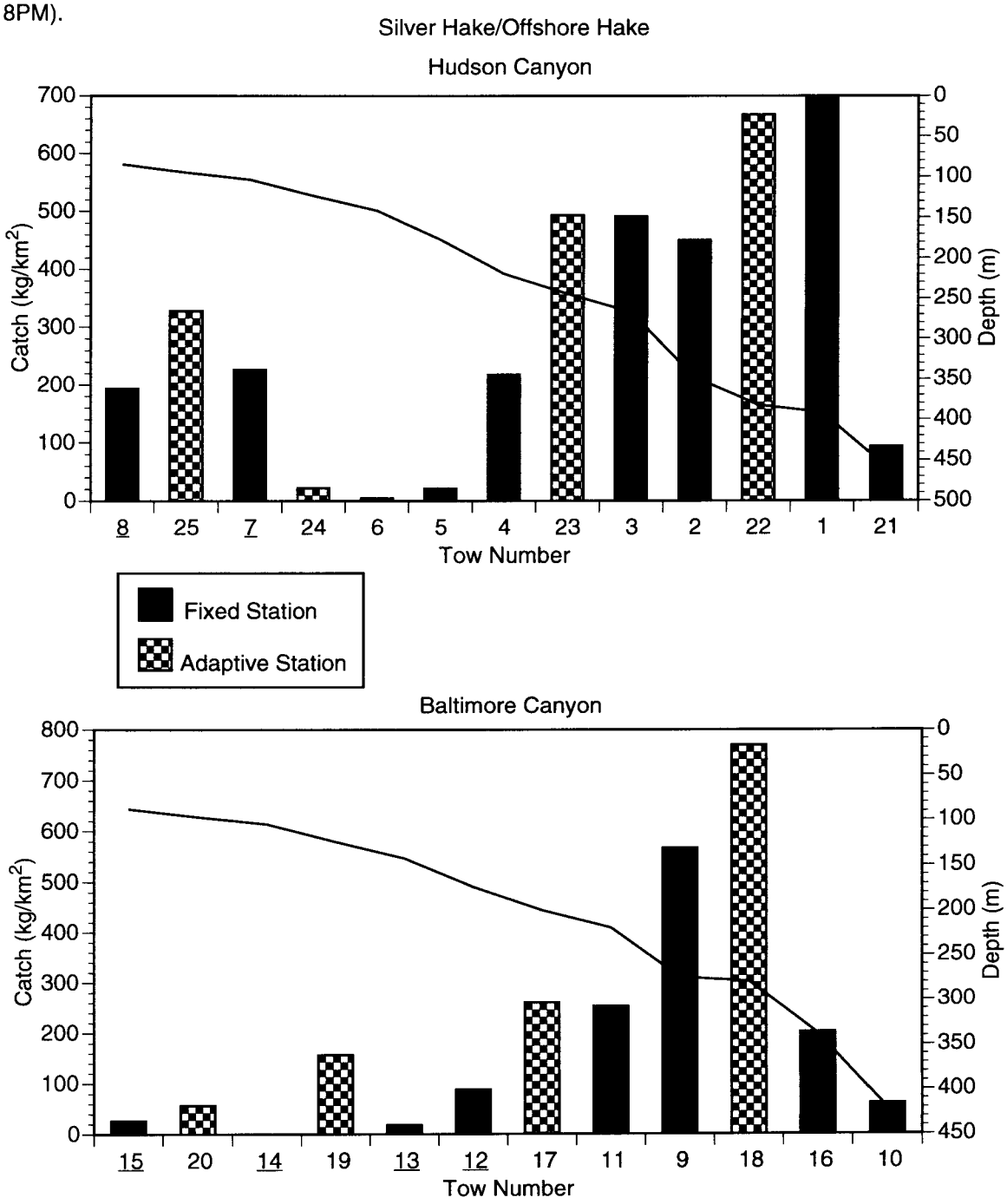


Figure 15b. Projected abundance of silver hake/offshore hake along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

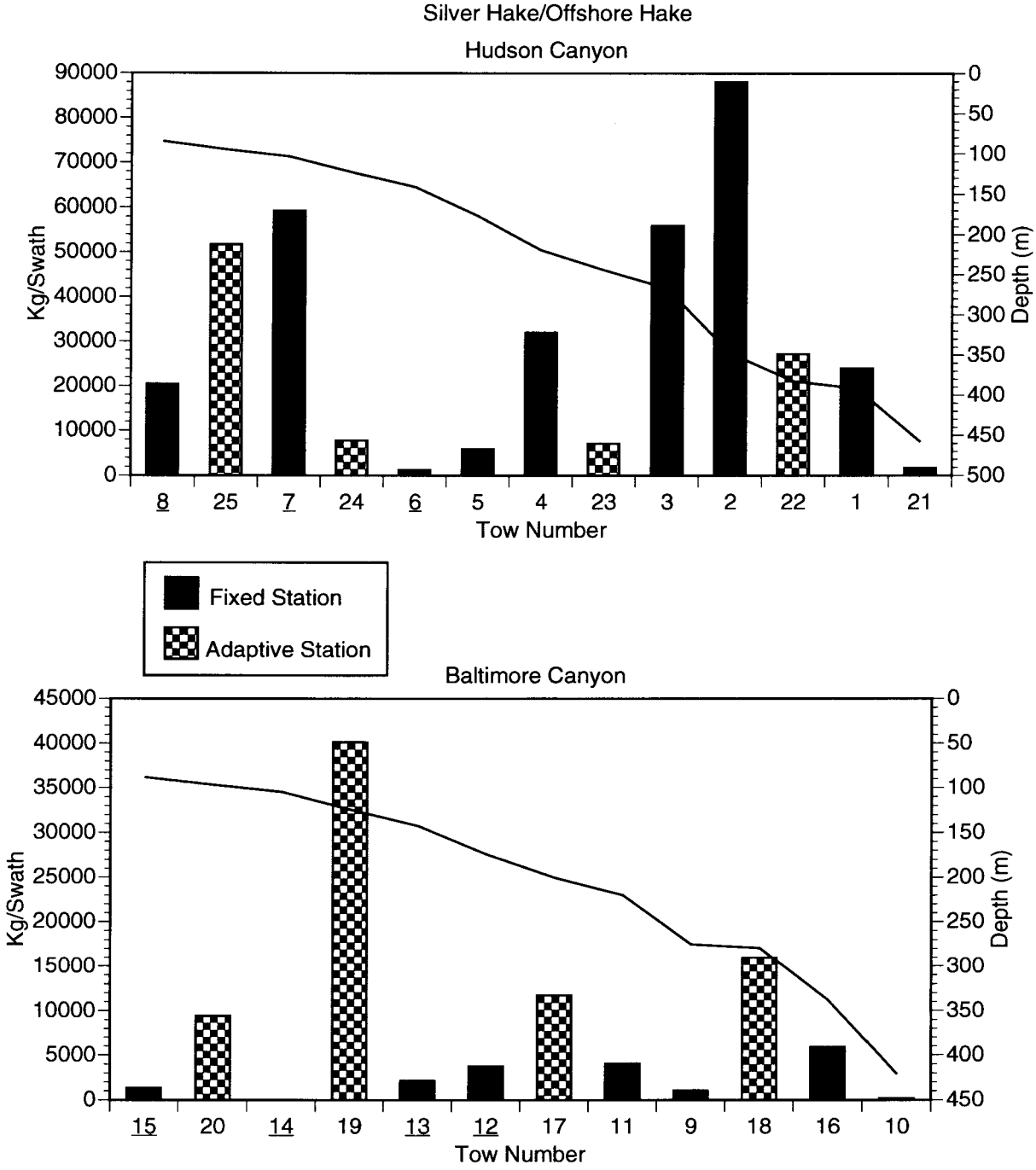


Figure 16a. Catches of spiny dogfish in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8 PM).

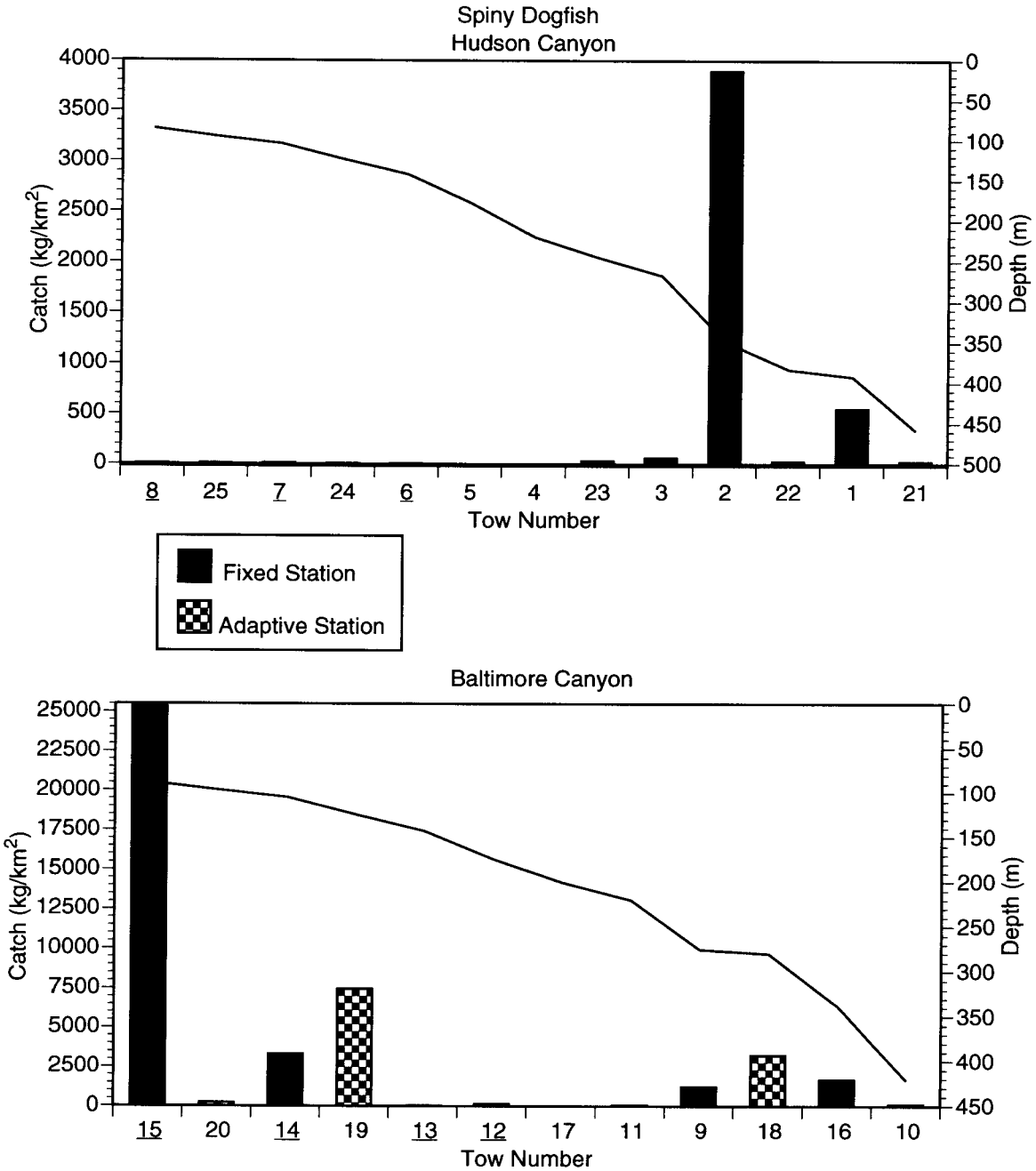


Figure 16b. Projected abundance of spiny dogfish along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

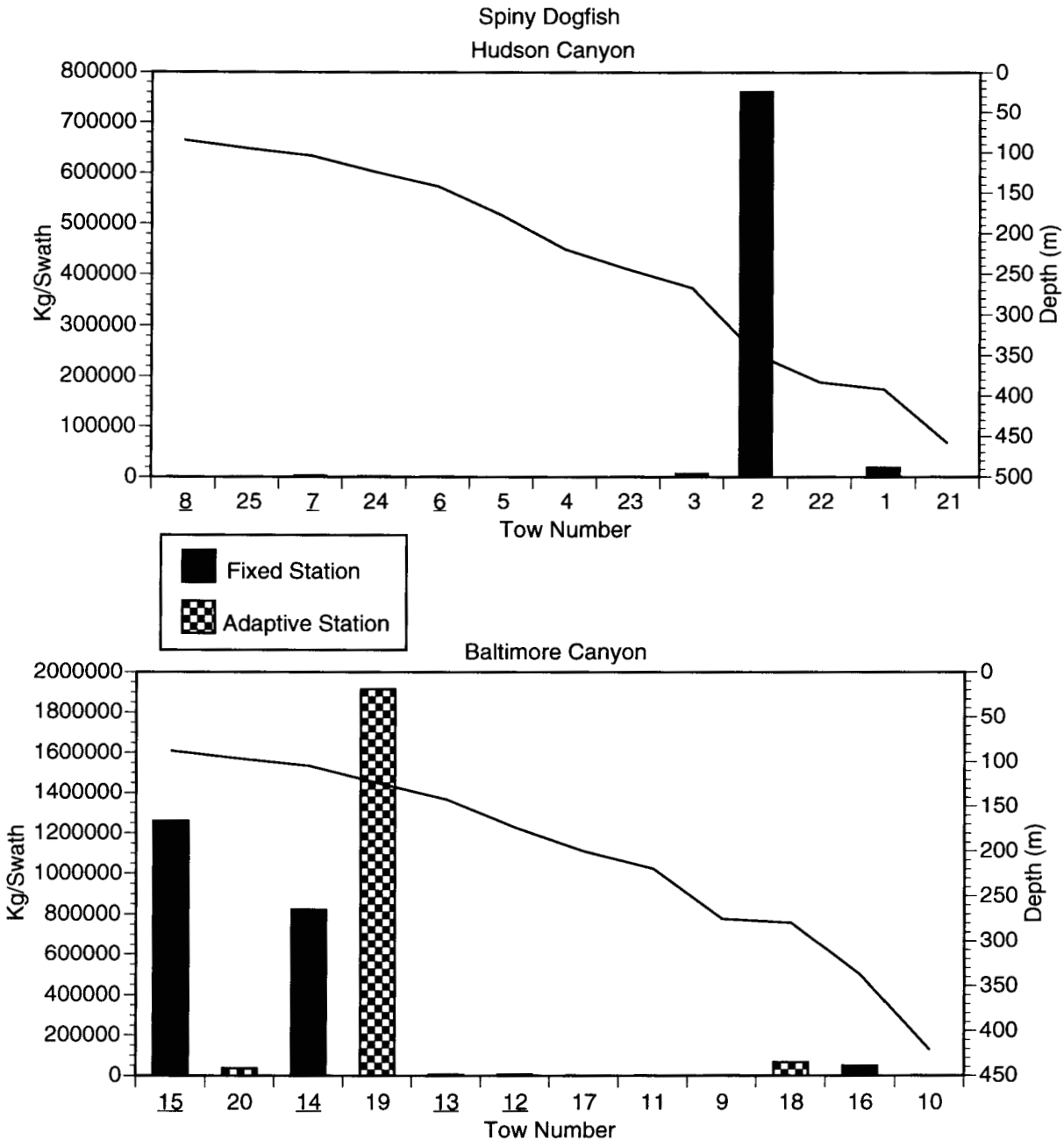


Figure 17a. Catches of spotted hake in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

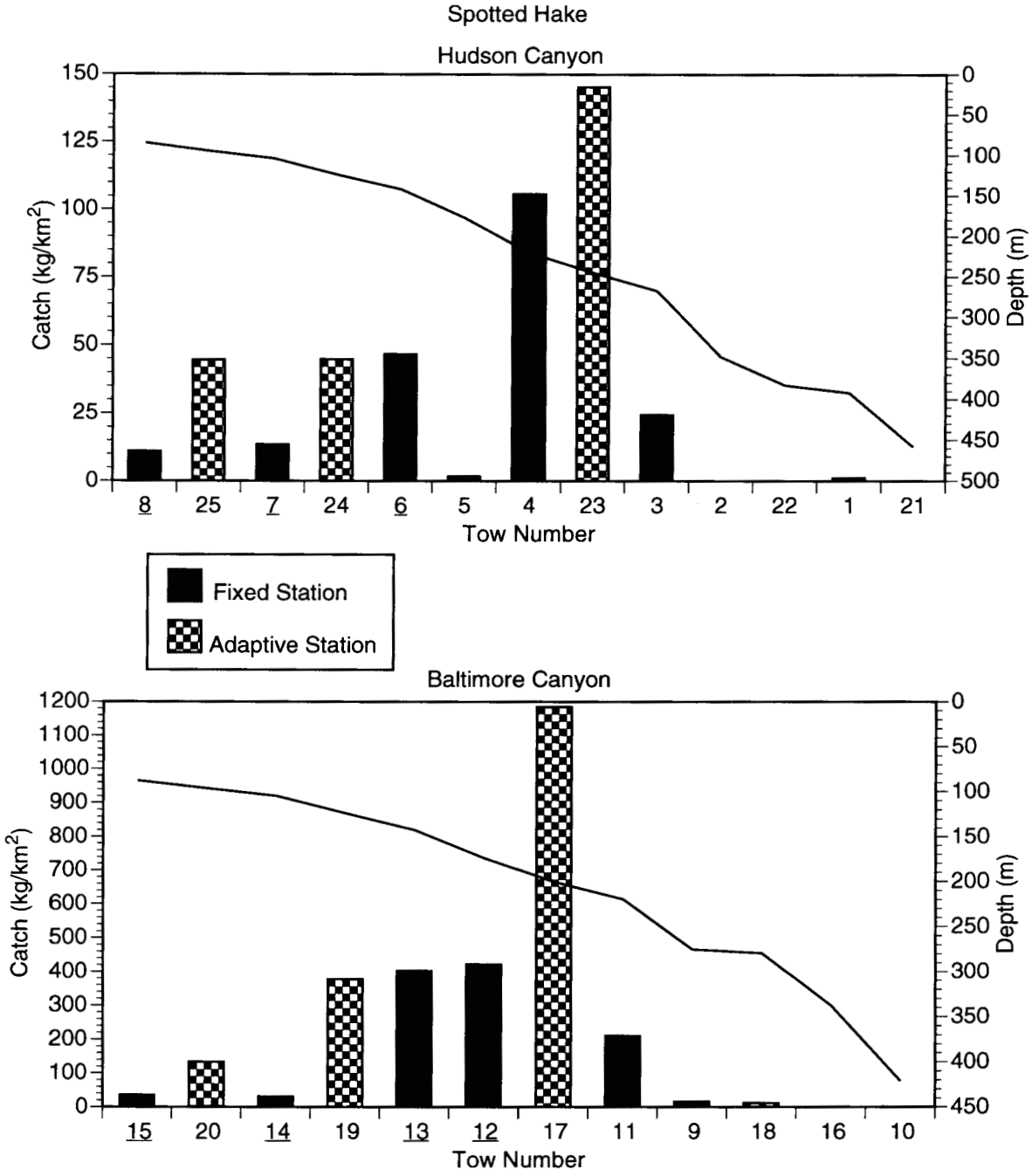


Figure 17b. Projected abundance of spotted hake along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

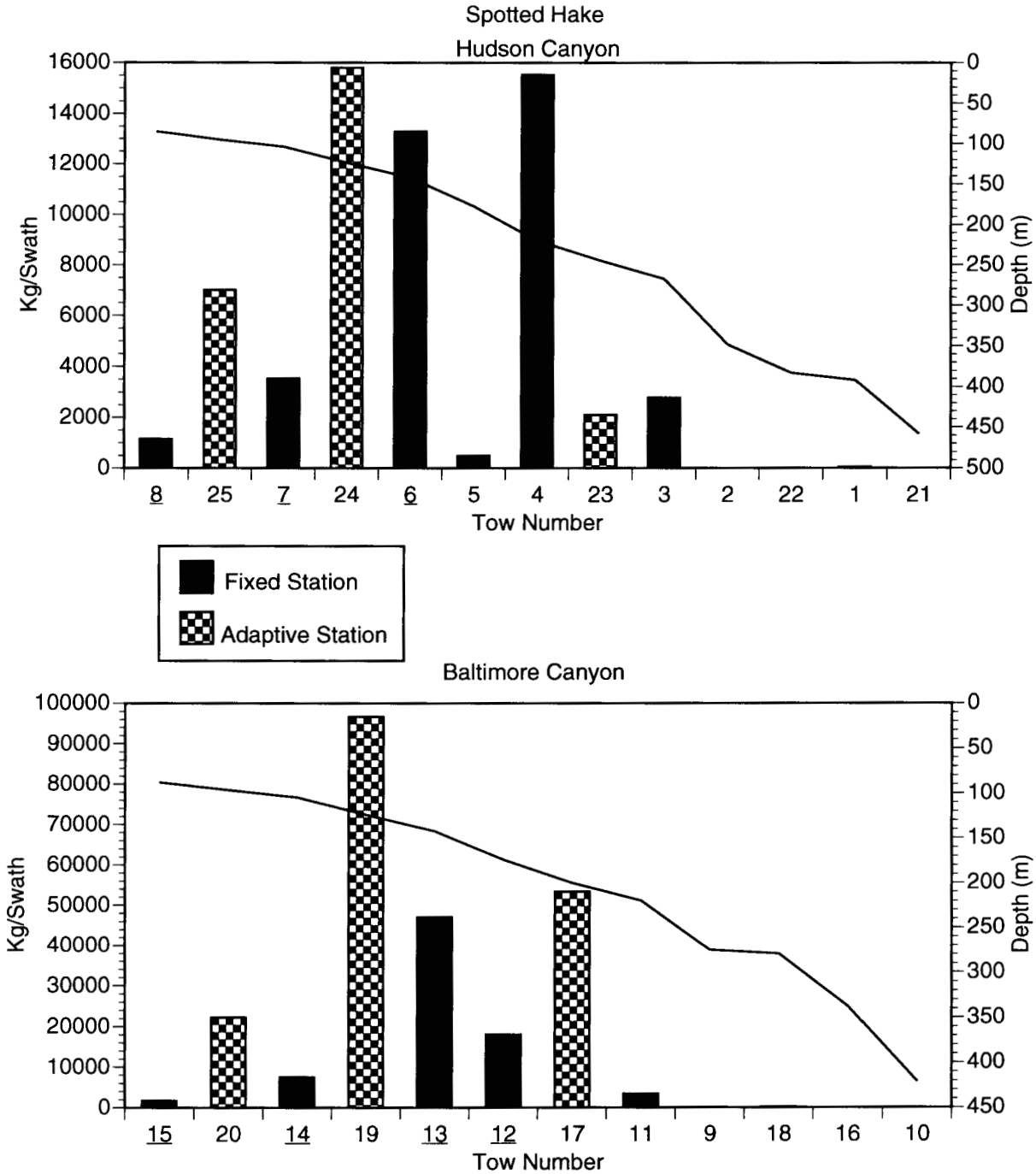


Figure 18a. Catches of summer flounder in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. underlined tow numbers indicate tows taken at night (after 8PM).

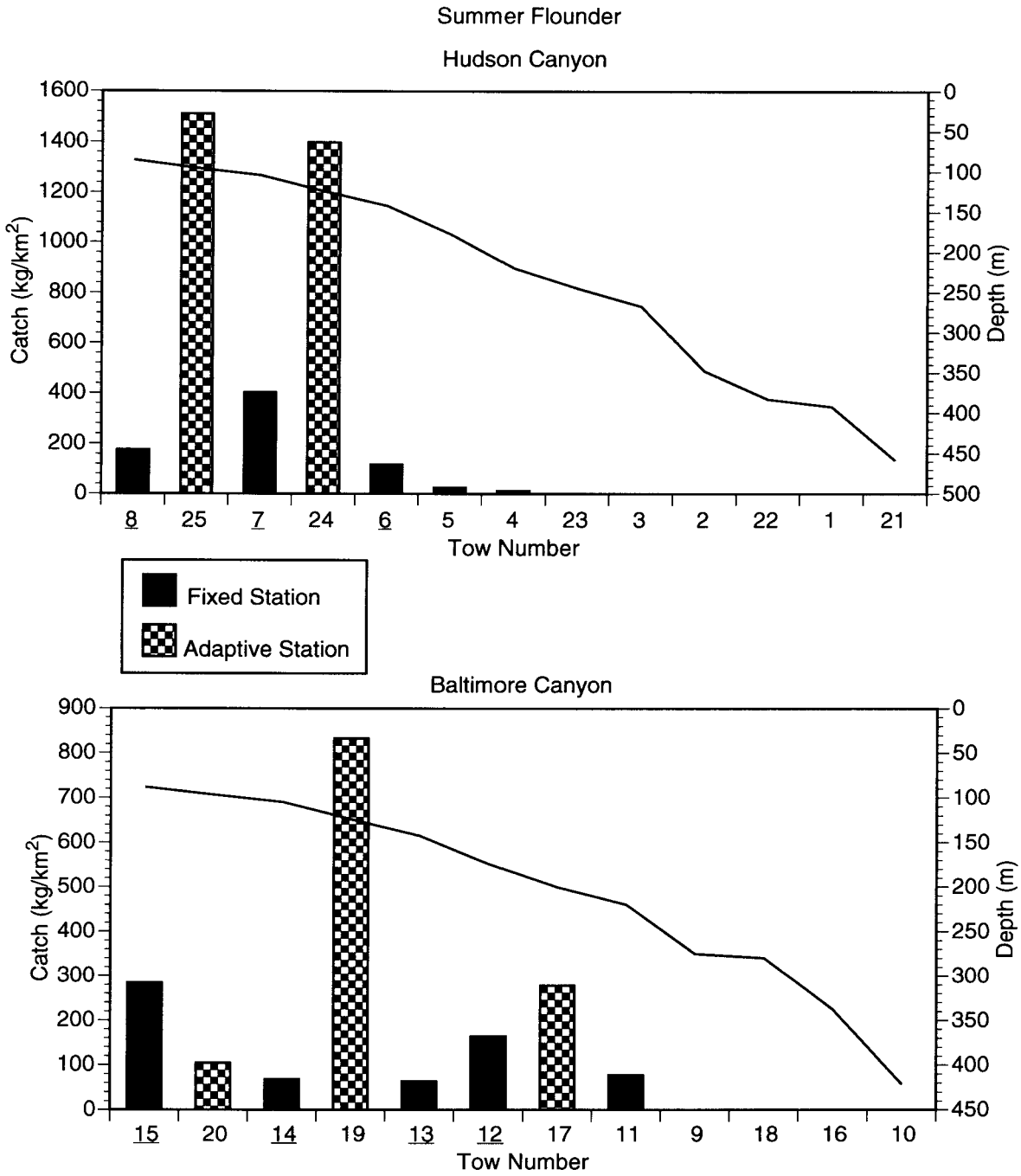


Figure 18b. Projected abundance of summer flounder along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

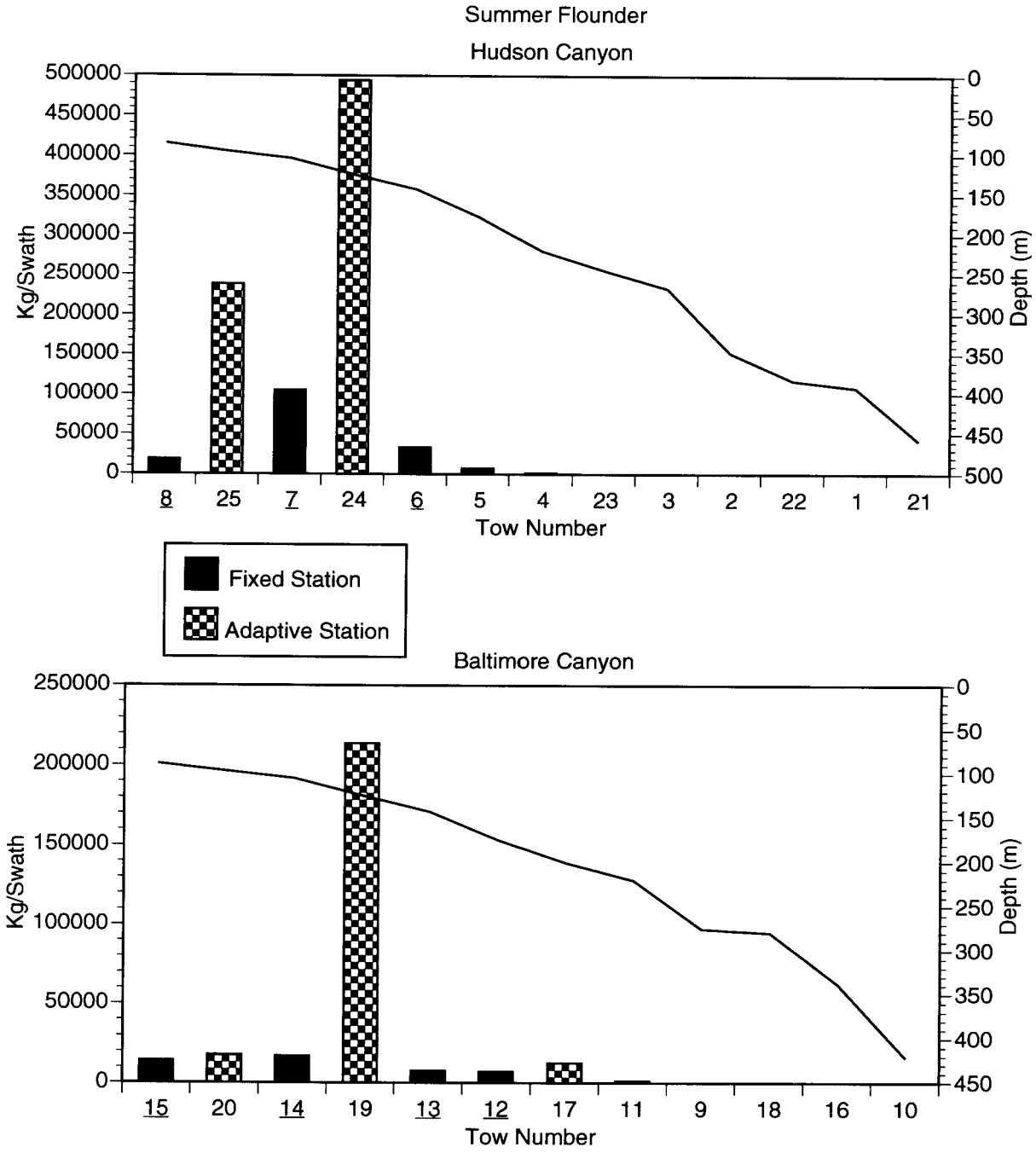


Figure 19a. Catches of tilefish in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

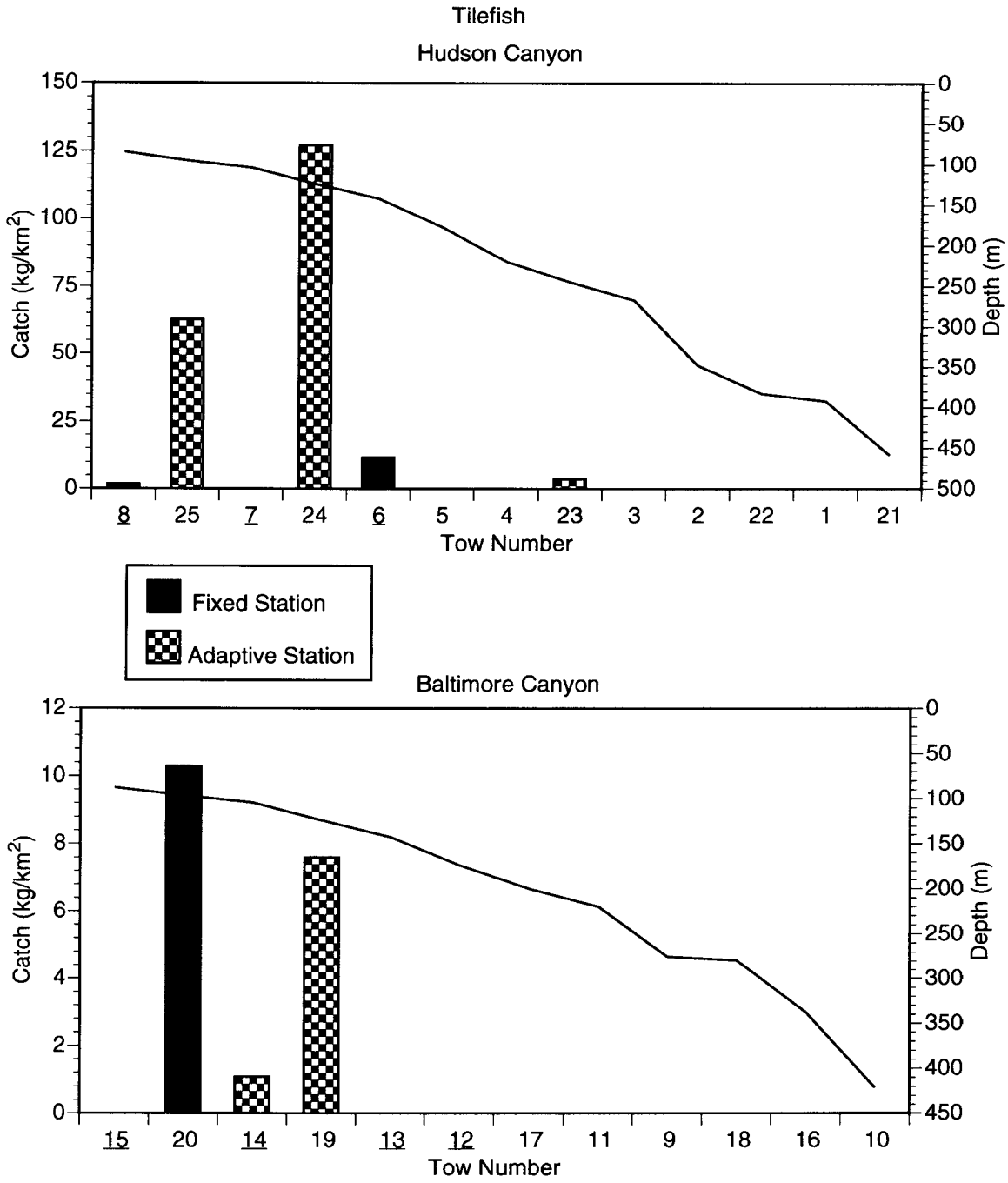


Figure 19b. Projected abundance of tilefish along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

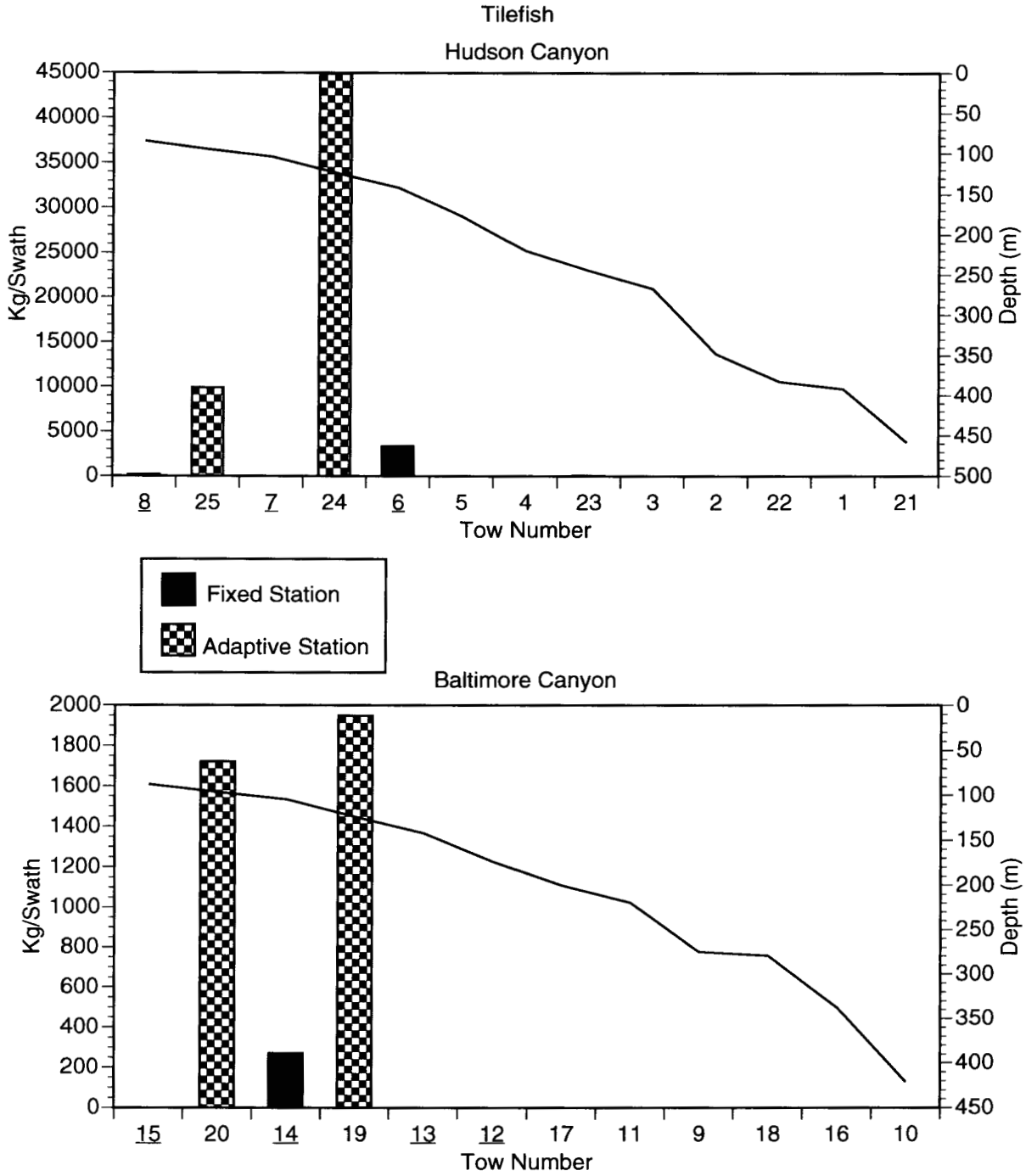


Figure 20a. Catches of witch flounder in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

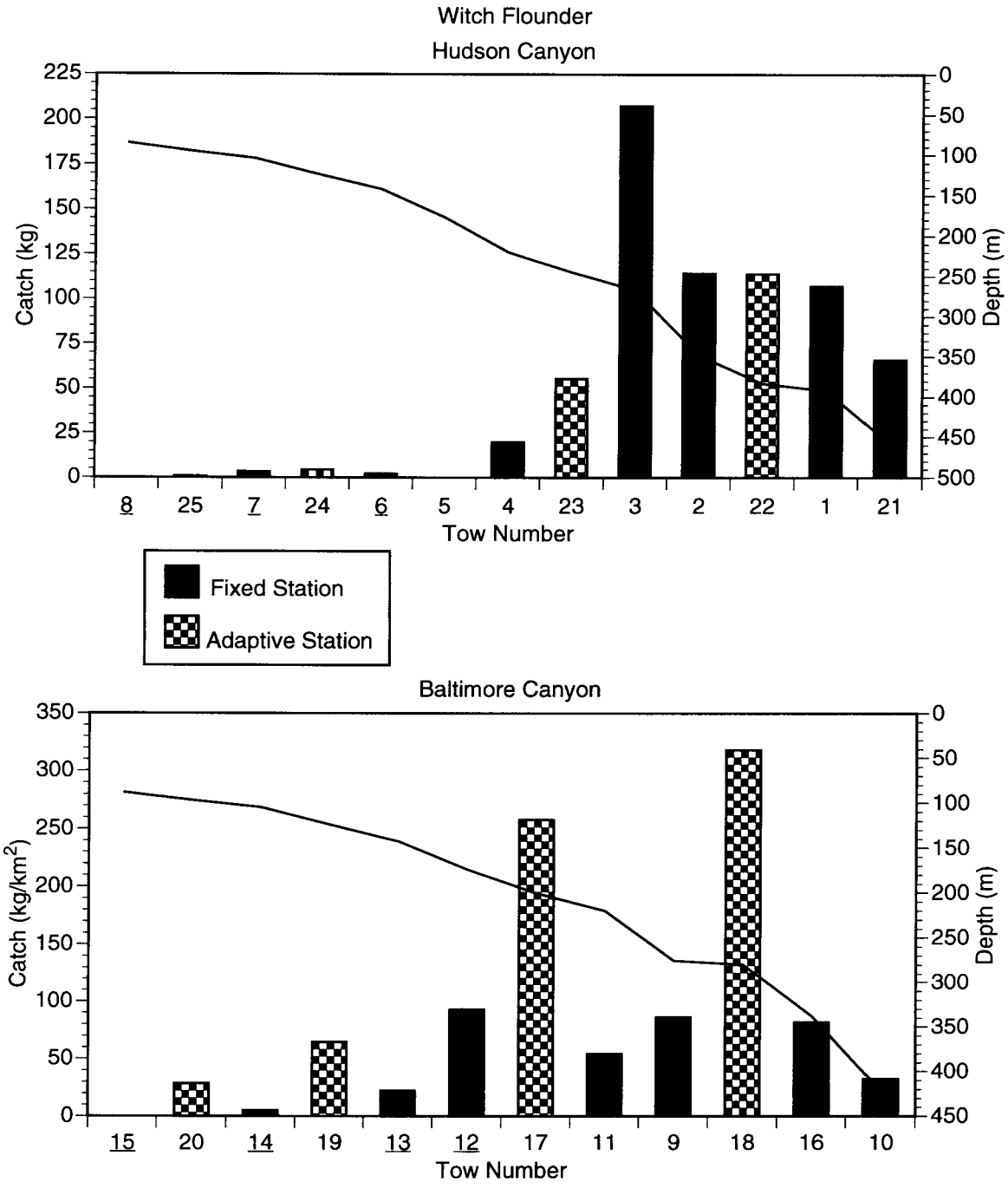


Figure 20b. Projected abundance of witch flounder along the transect with each tow representing the projected abundance for the distance along the transect (swath in Table 1). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined tow numbers indicate tows taken at night (after 8PM).

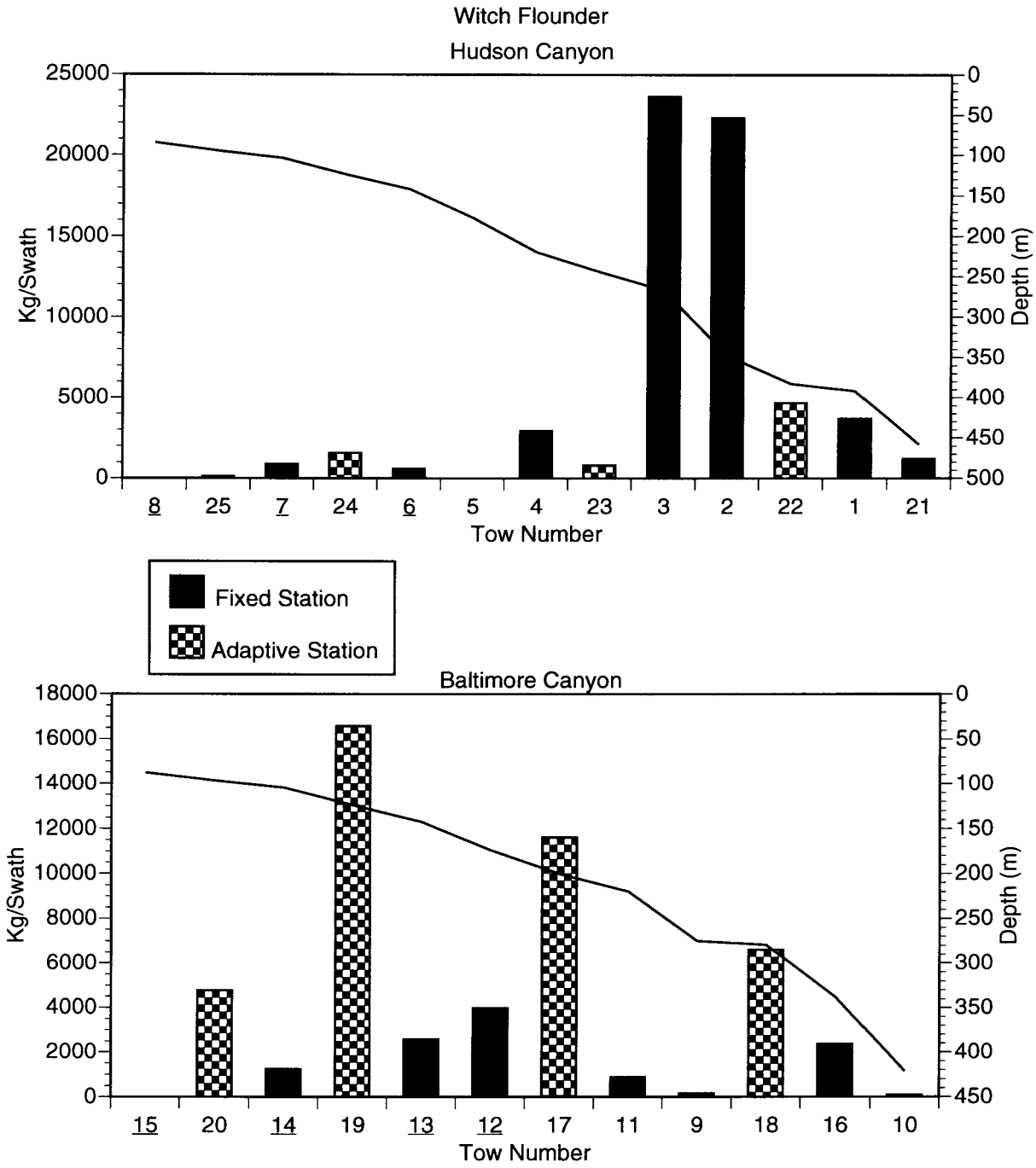


Figure 21. Catches of all species in each tow along the two transects. Catch is recorded in kg caught/swept area (km^2). Depth is the average depth at which each tow was made (in meters). Tow numbers indicate the sampling sequence during the cruise. Tows are ordered shallowest to deepest along the x-axis. Underlined to wnumbers indicate tows taken at night (after 8PM).

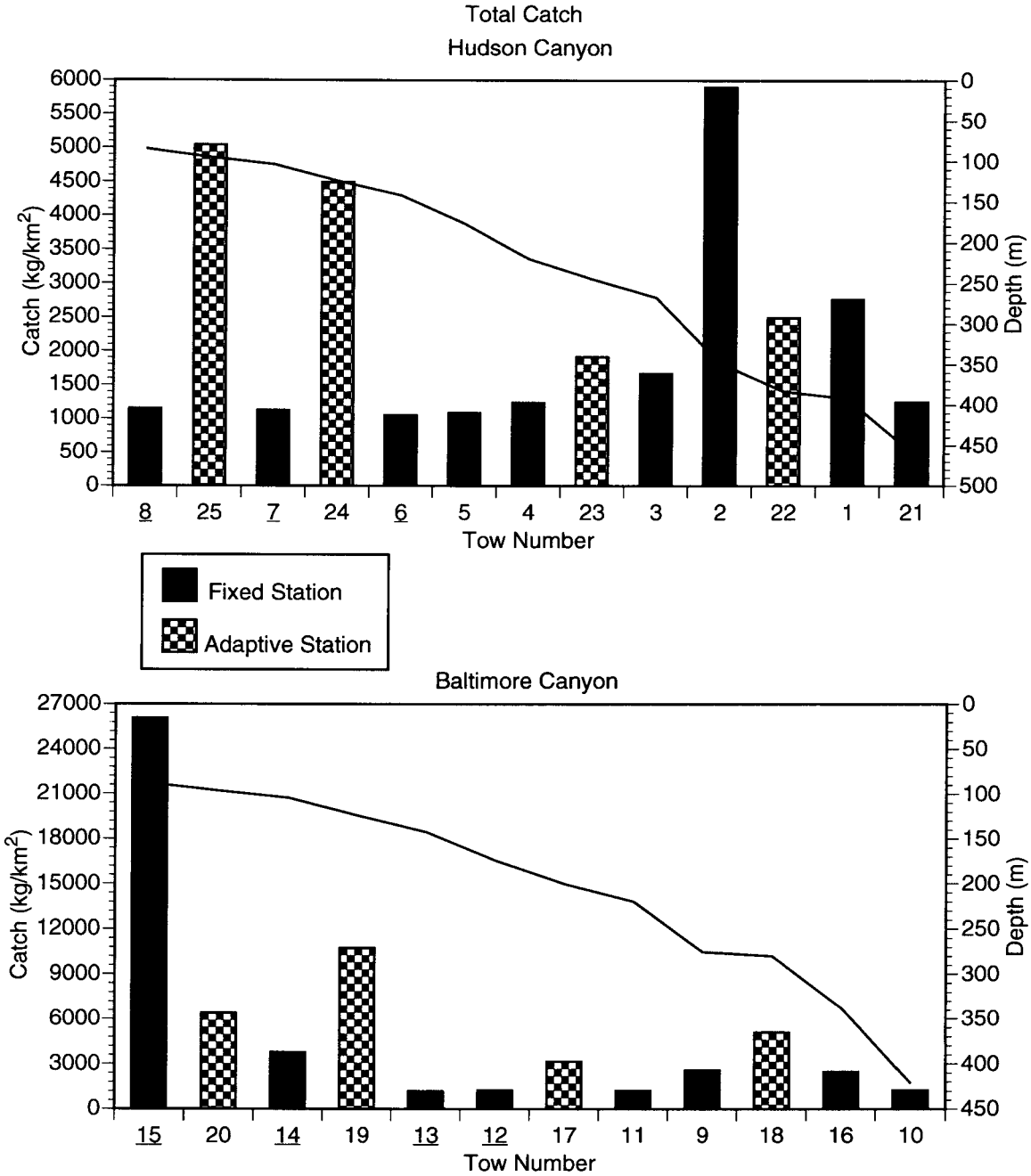


Figure 22a. Cumulative size-frequency distribution of American lobster across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

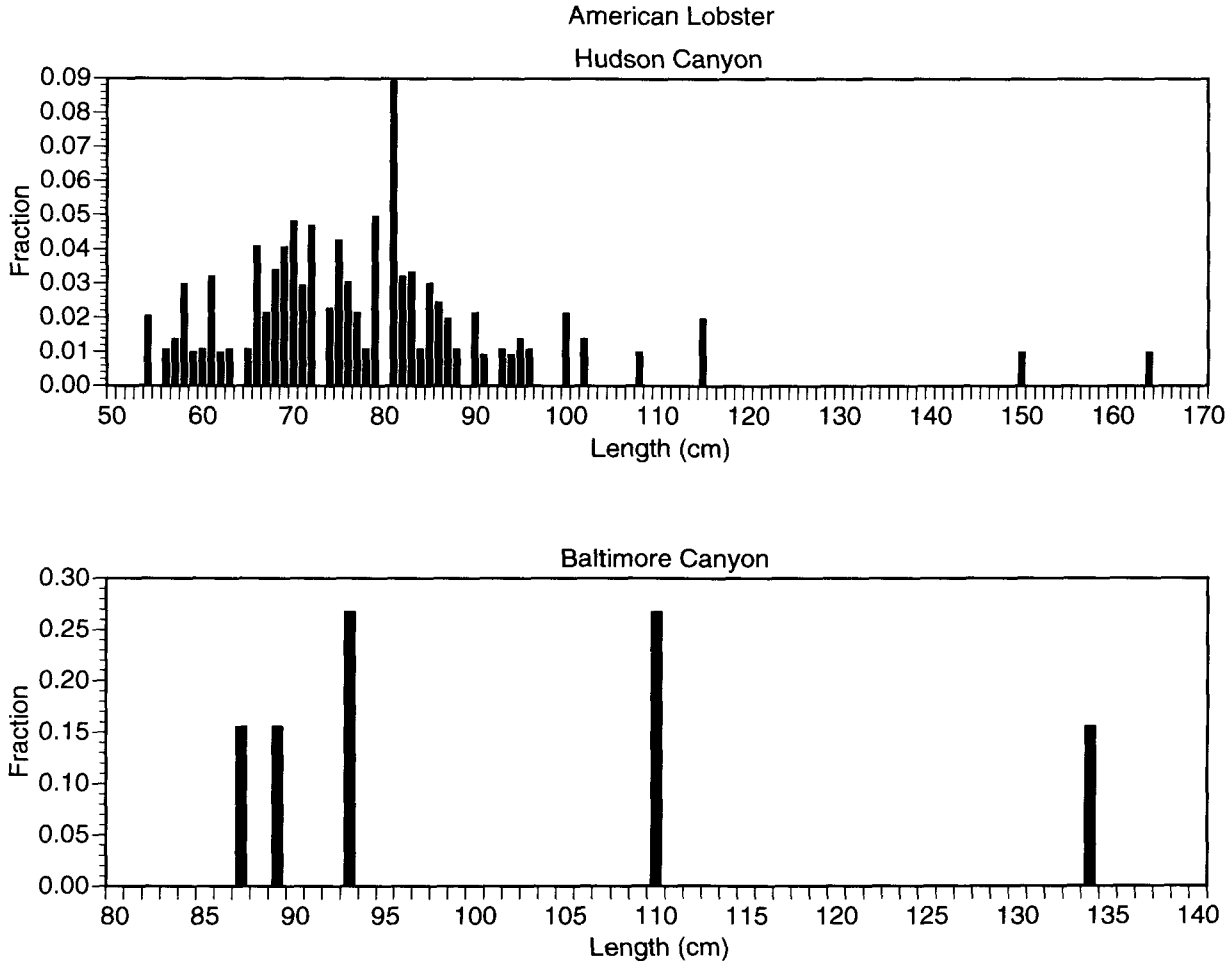
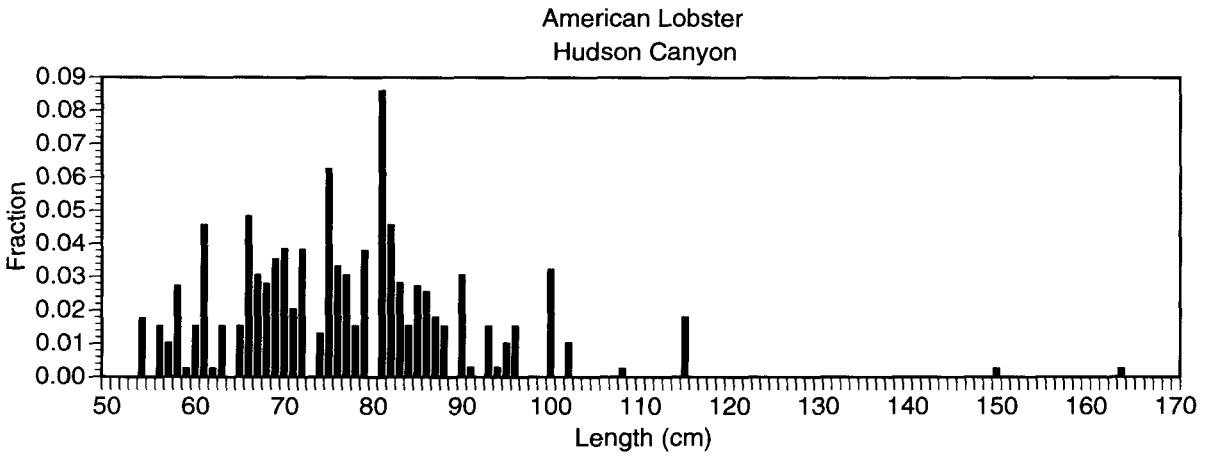


Figure 22b. Cumulative size-frequency distribution of American lobster across all tows. Tow size frequencies were corrected to the number caugh per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.



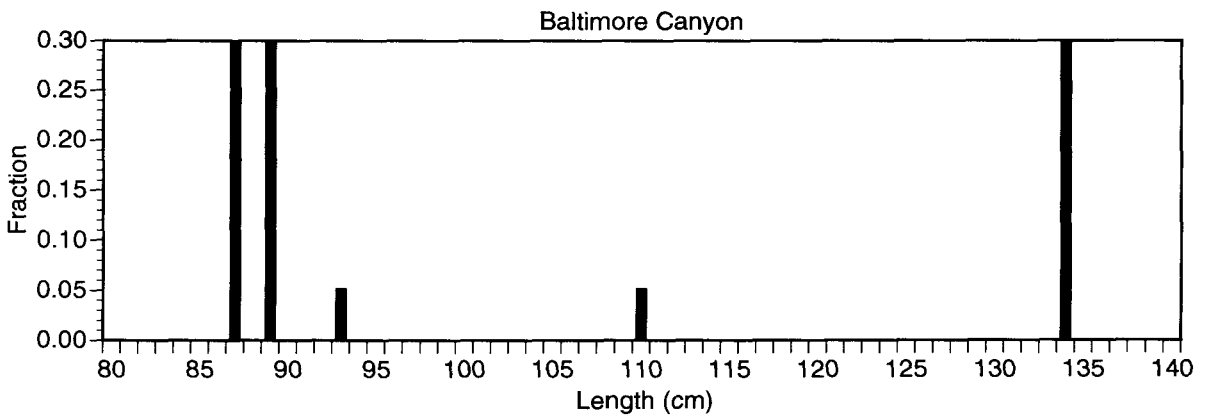


Figure 23a. Cumulative size-frequency distribution of black sea bass across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

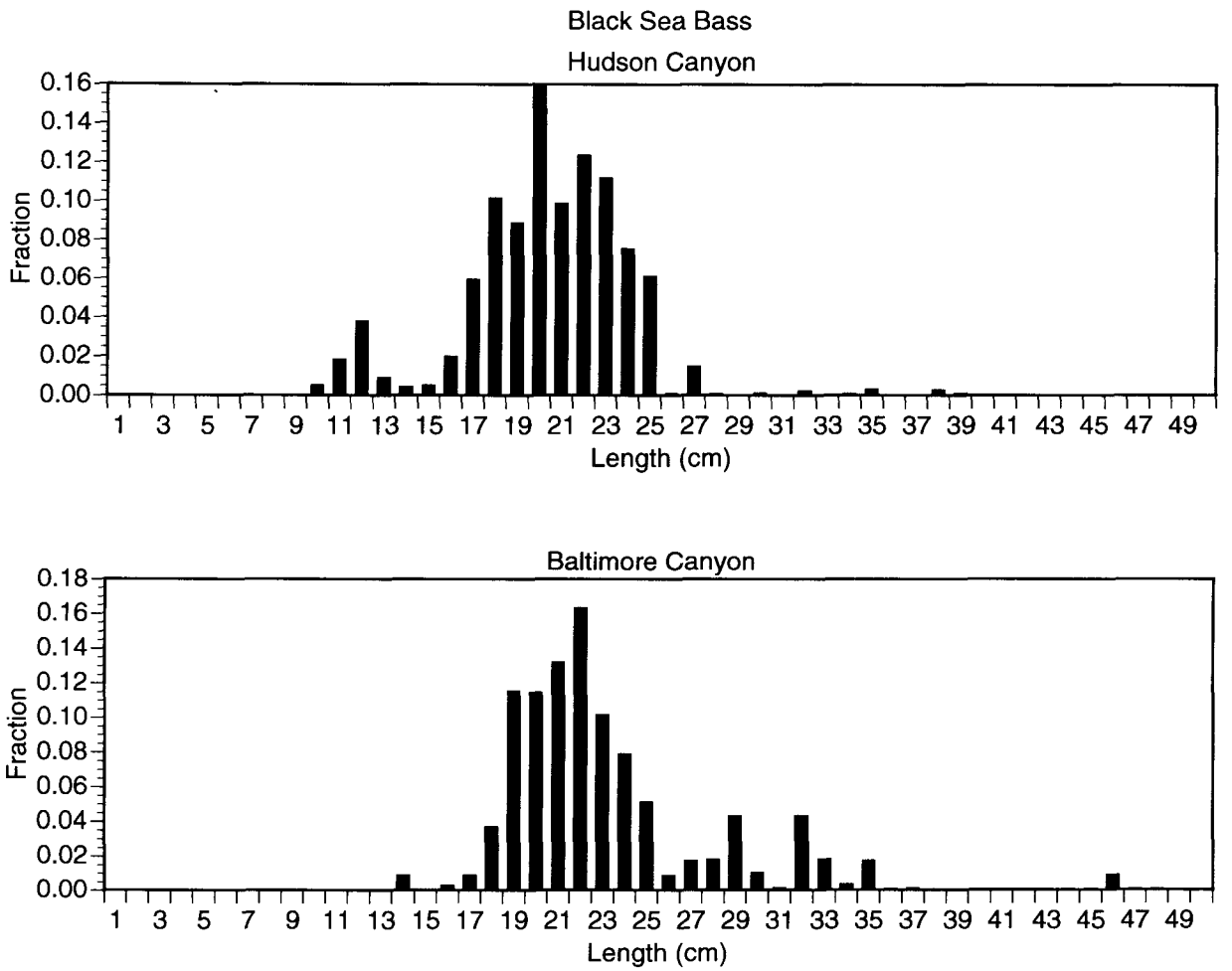


Figure 23b. Cumulative size-frequency distribution of black sea bass across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

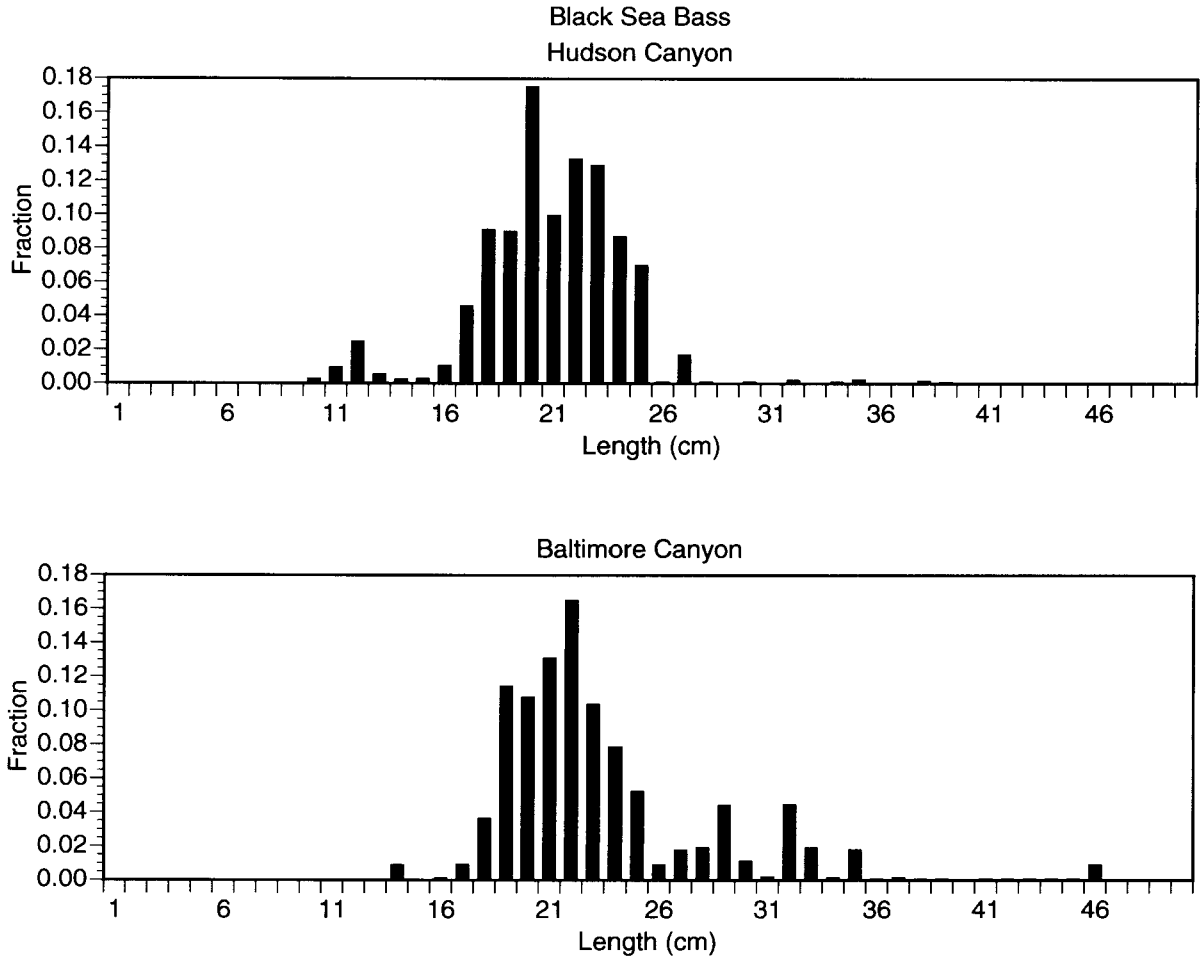


Figure 24a. Cumulative size-frequency distribution of *Loligo* squid across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

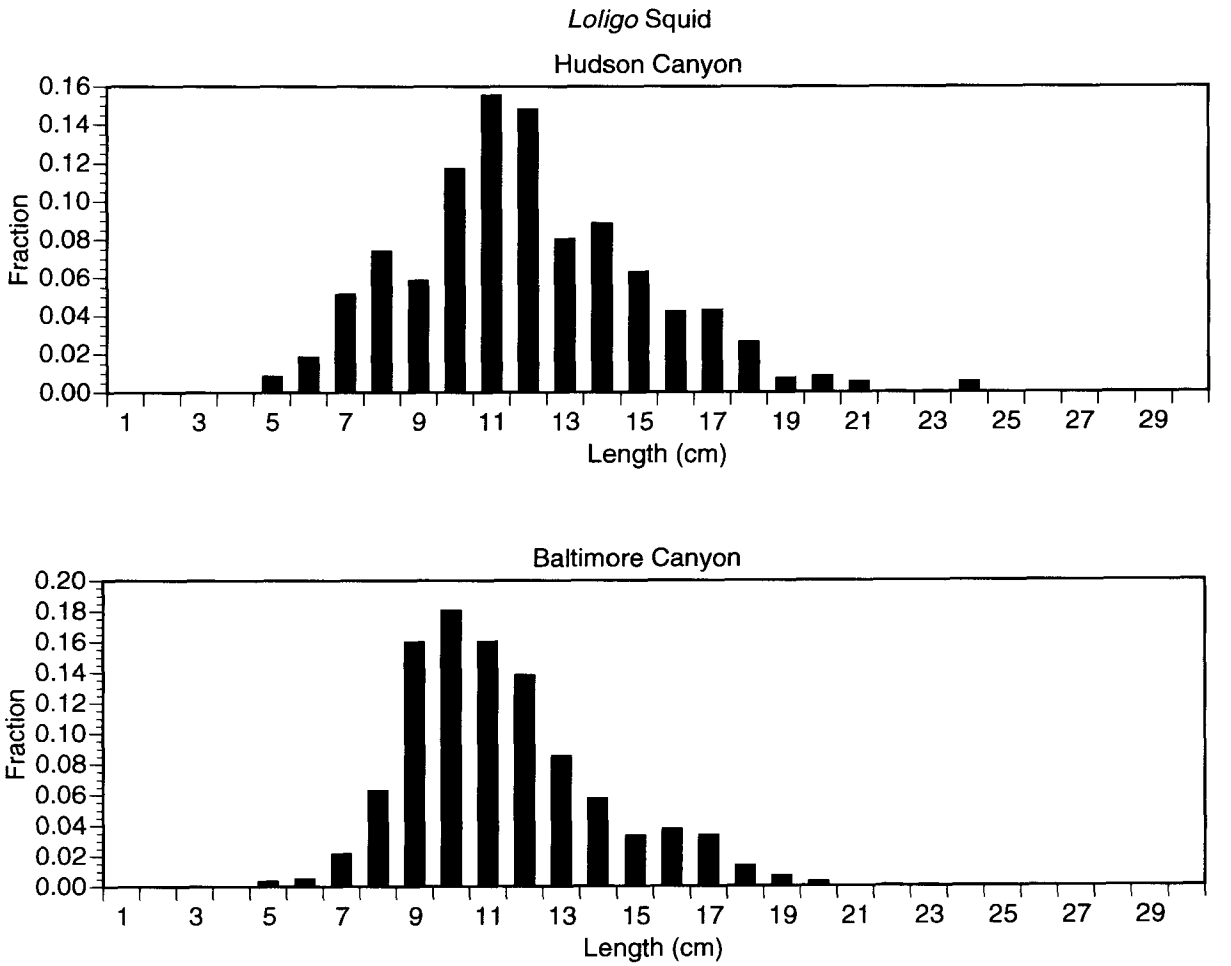


Figure 24b. Cumulative size-frequency distribution of *Loligo* squid across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

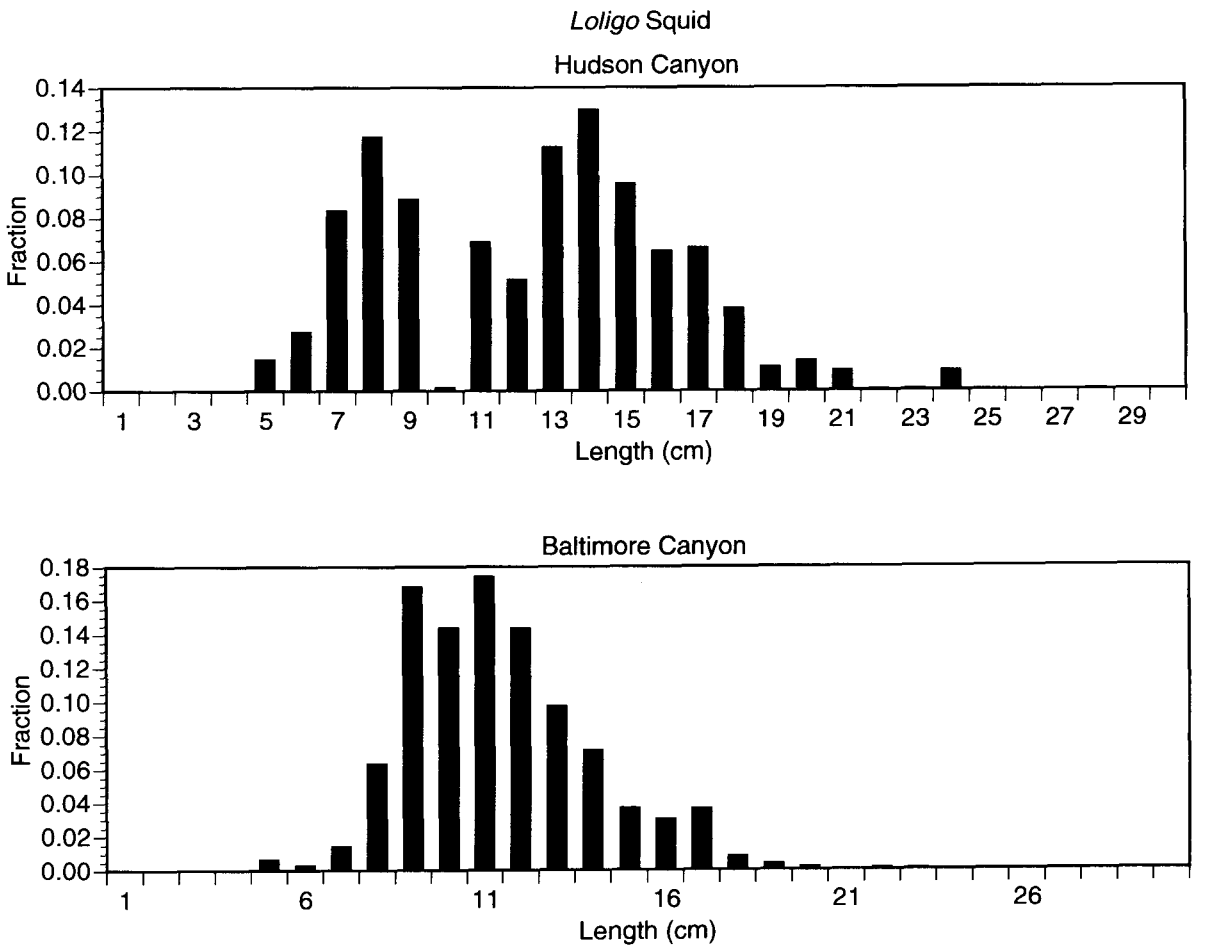


Figure 25b. Cumulative size-frequency distribution of monkfish across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

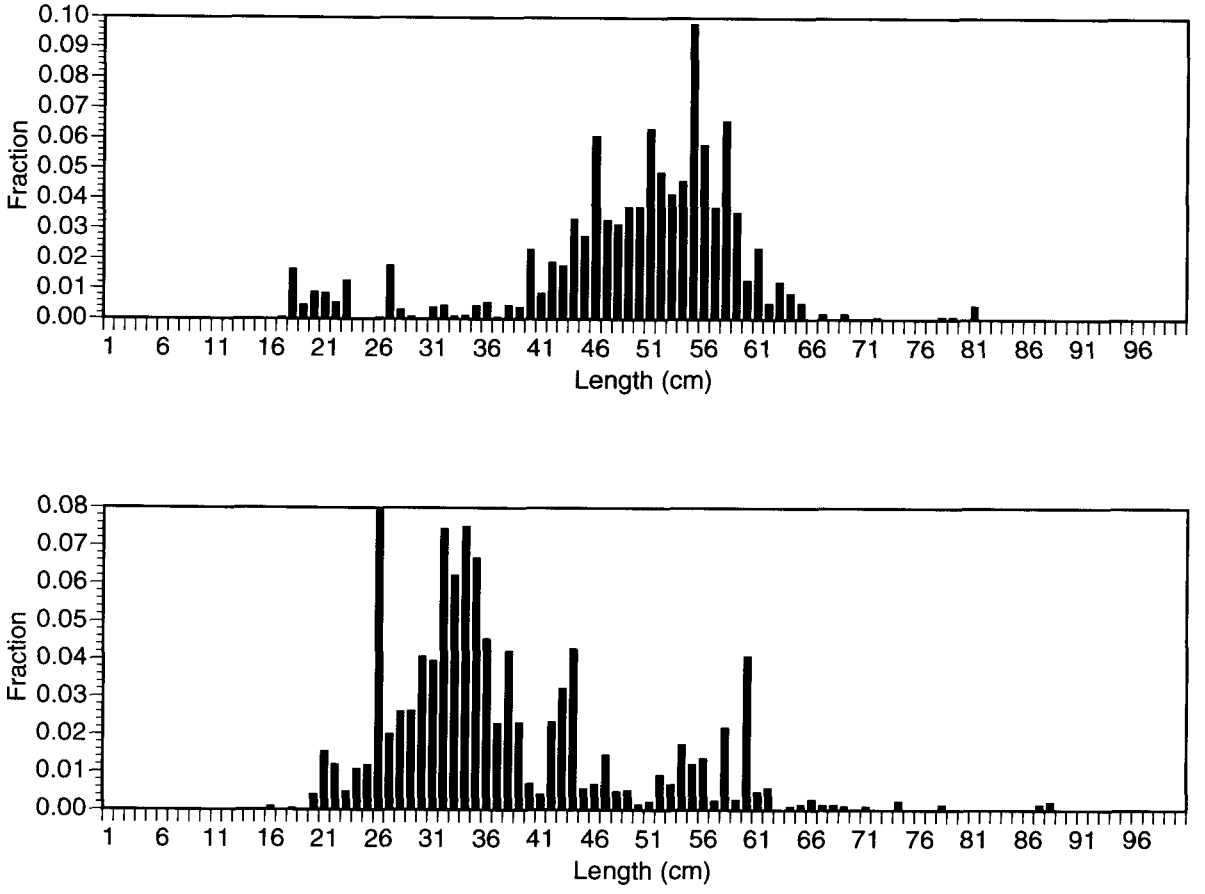


Figure 26a. Cumulative size-frequency distribution of scup across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

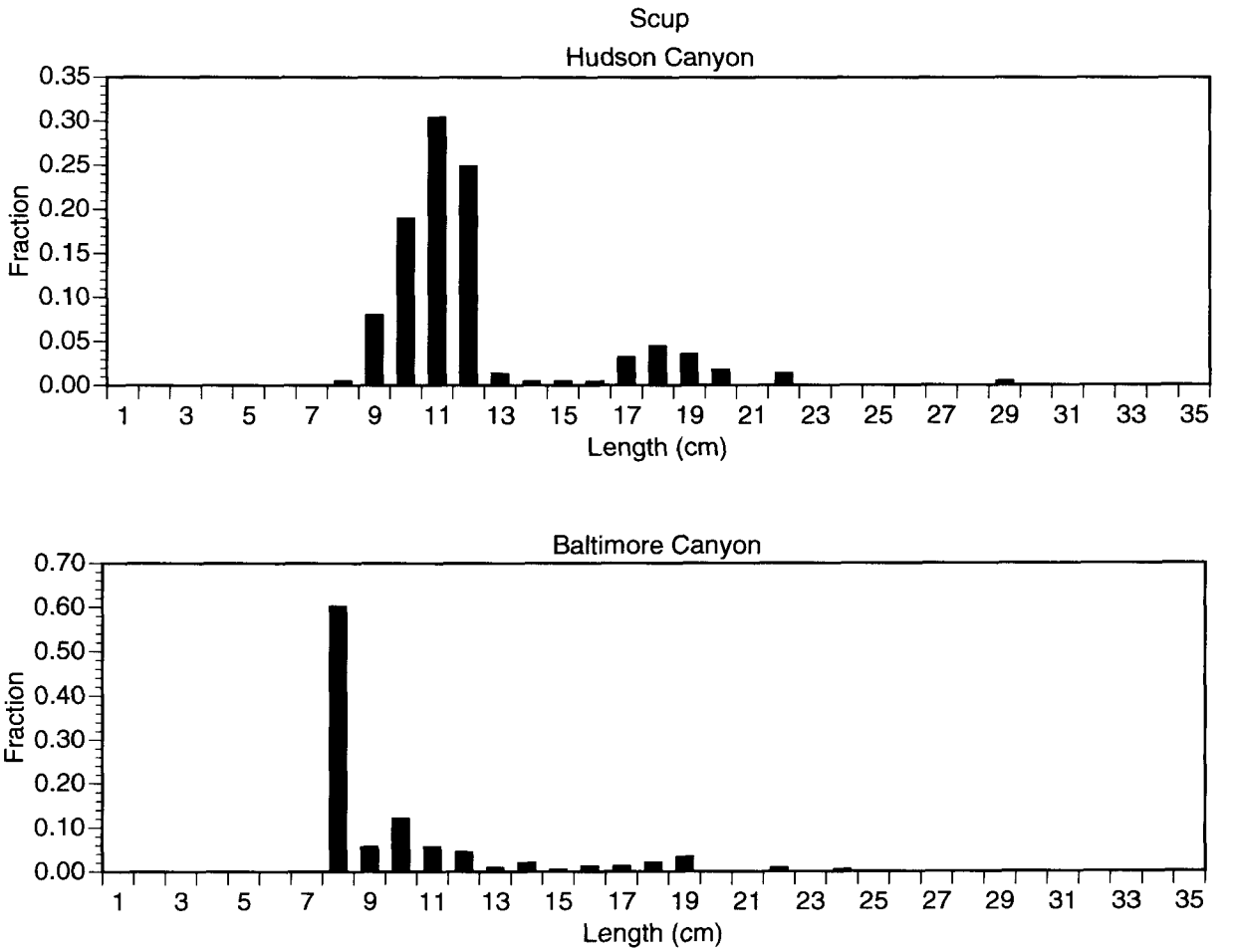


Figure 25a. Cumulative size-frequency distribution of monkfish across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

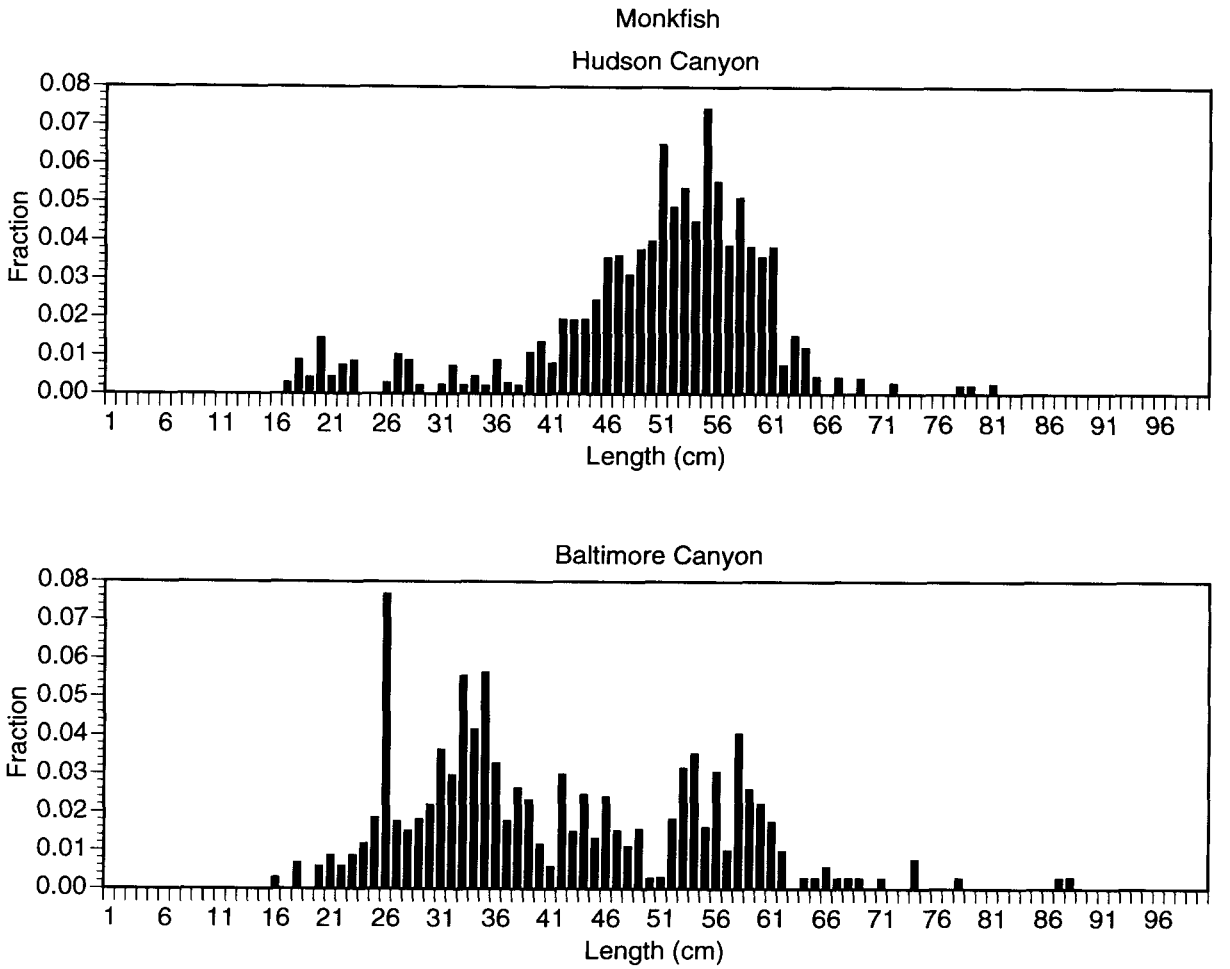


Figure 26b. Cumulative size-frequency distribution of scup across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

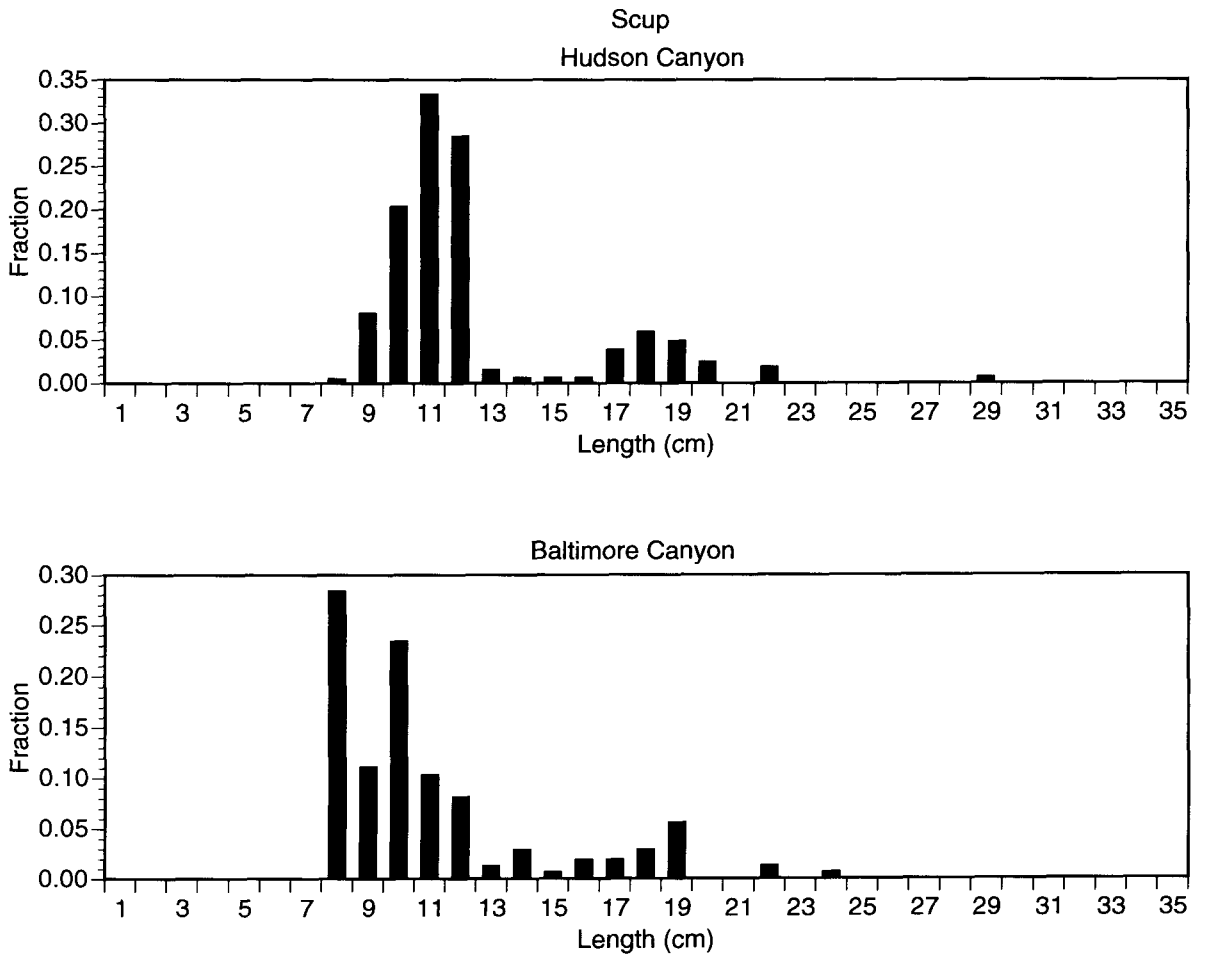


Figure 27a. Cumulative size-frequency distribution of spiny dogfish across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

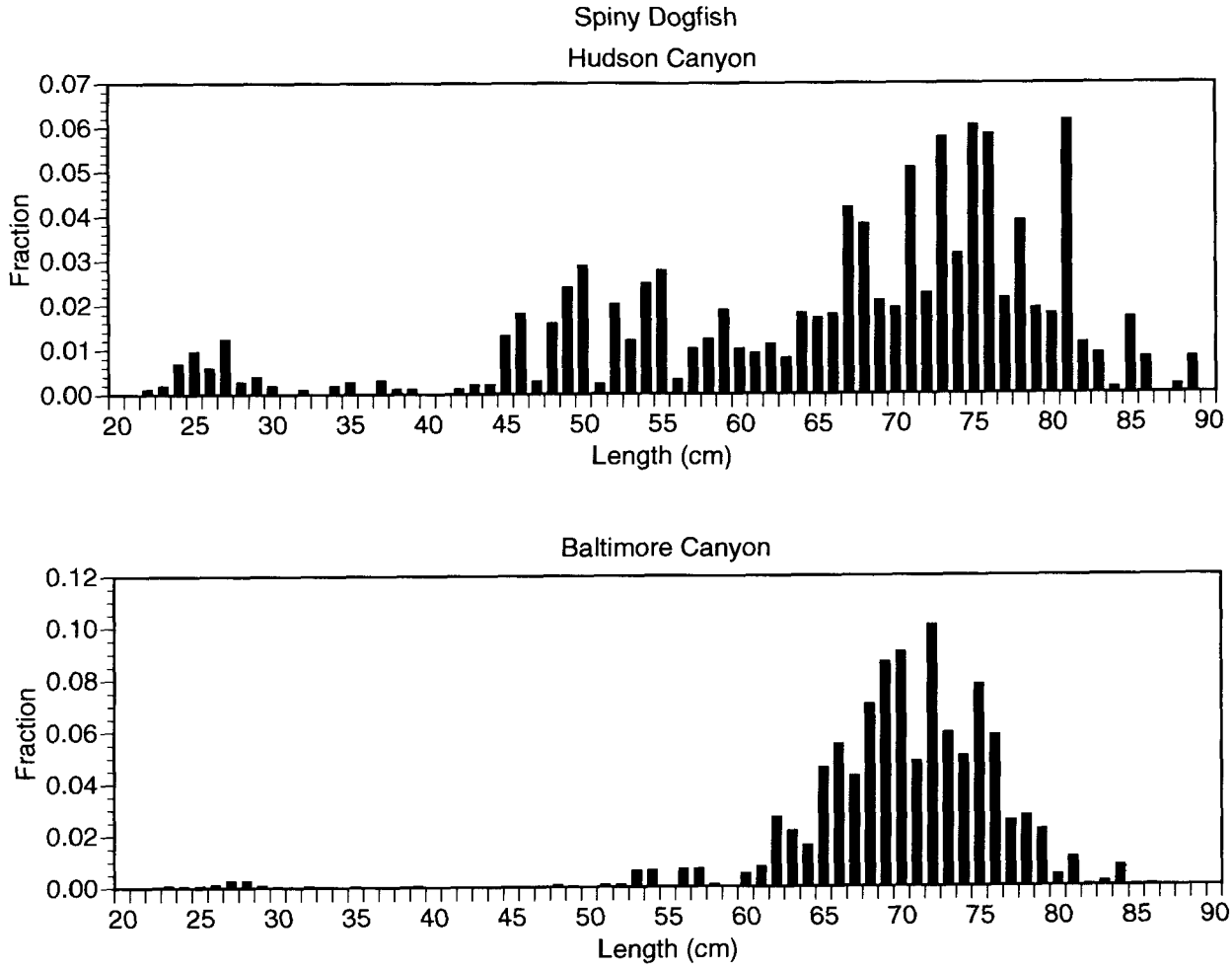


Figure 27b. Cumulative size-frequency distribution of spiny dogfish across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

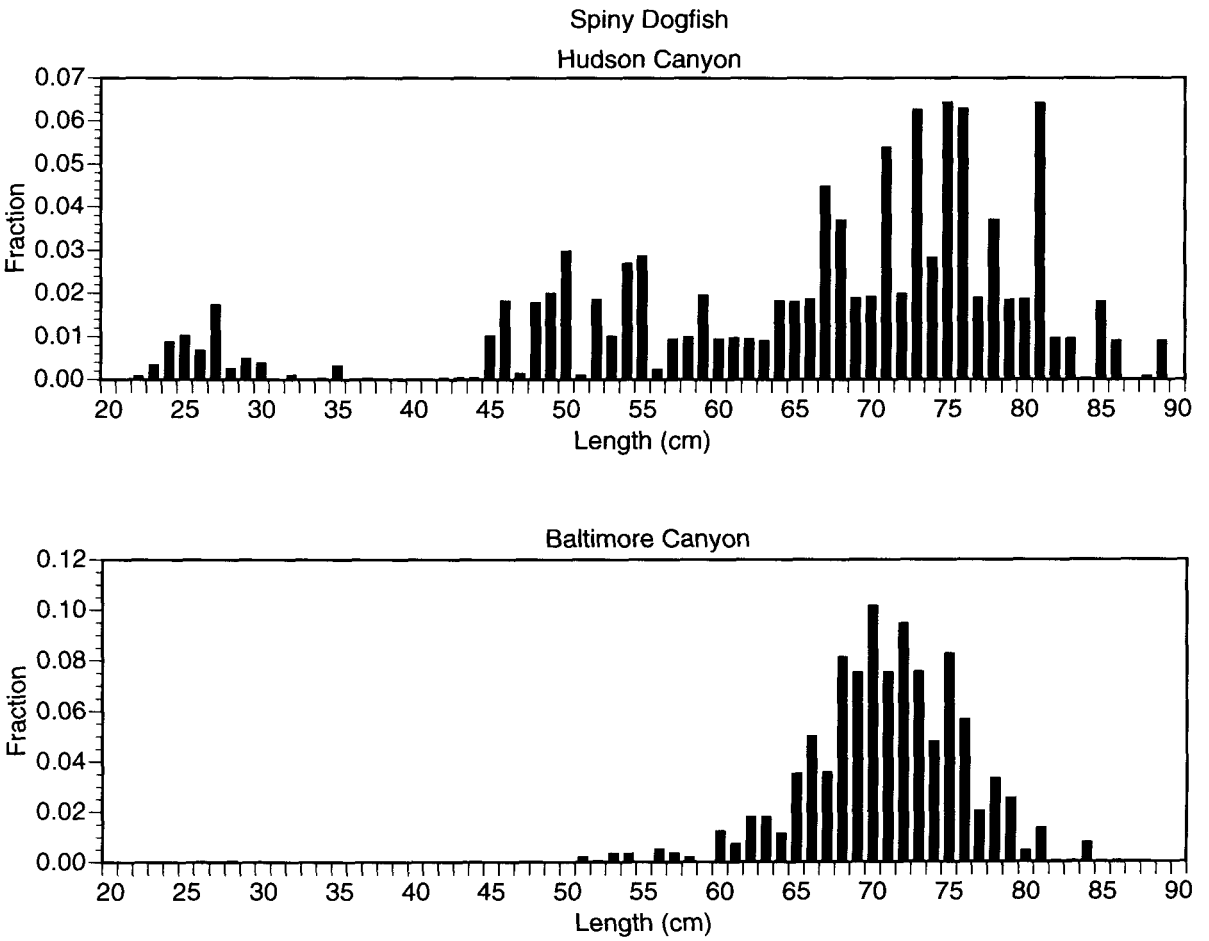


Figure 28a. Cumulative size-frequency distribution of summer flounder across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. The swept area-normalized abundances were then summed across all tows for each transect.

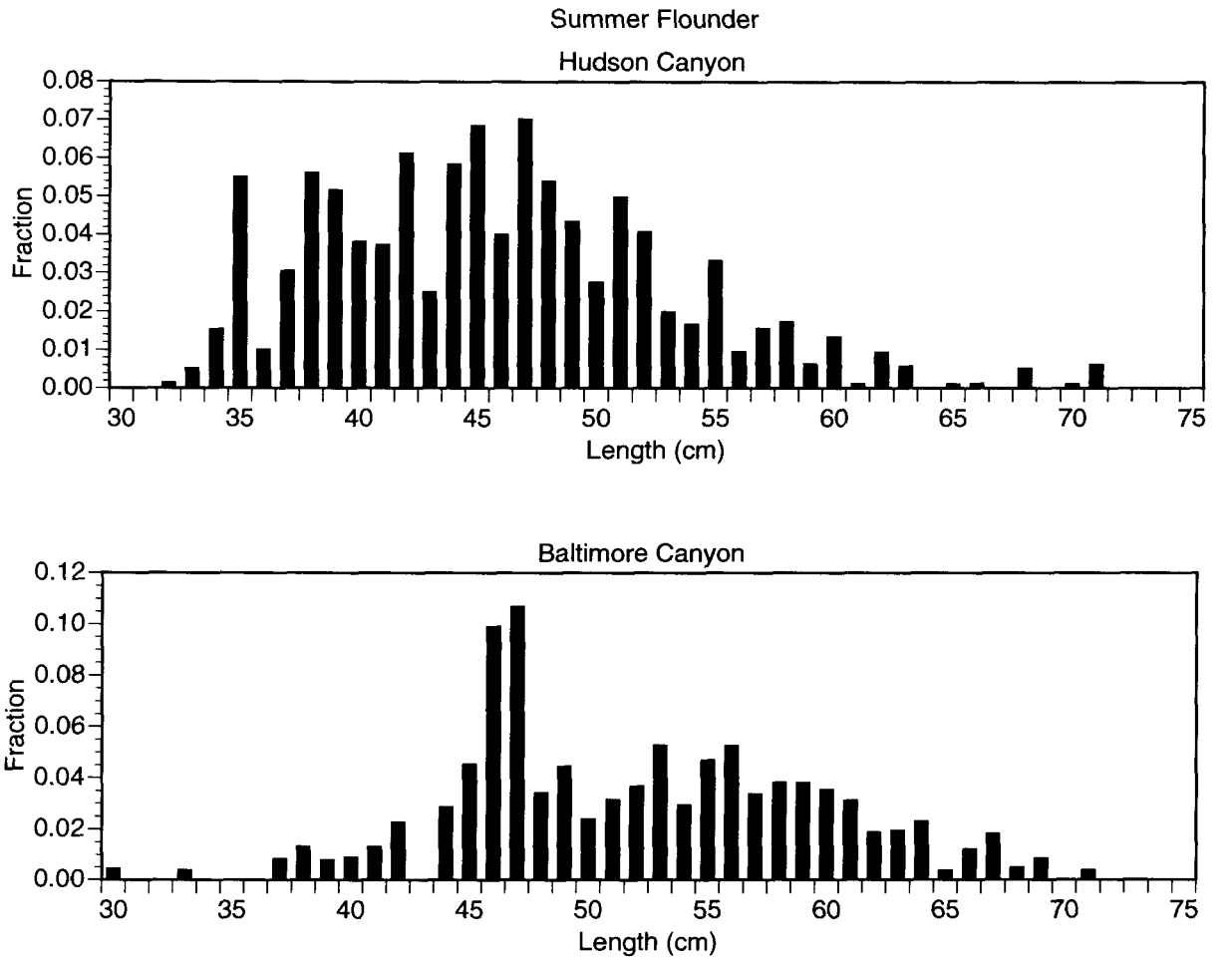


Figure 28b. Cumulative size-frequency distribution of summer flounder across all tows. Tow size frequencies were corrected to the number caught per size class per km^2 swept area. Tows were then normalized to swath distance along the transect and the abundances were summed across all tows for each transect.

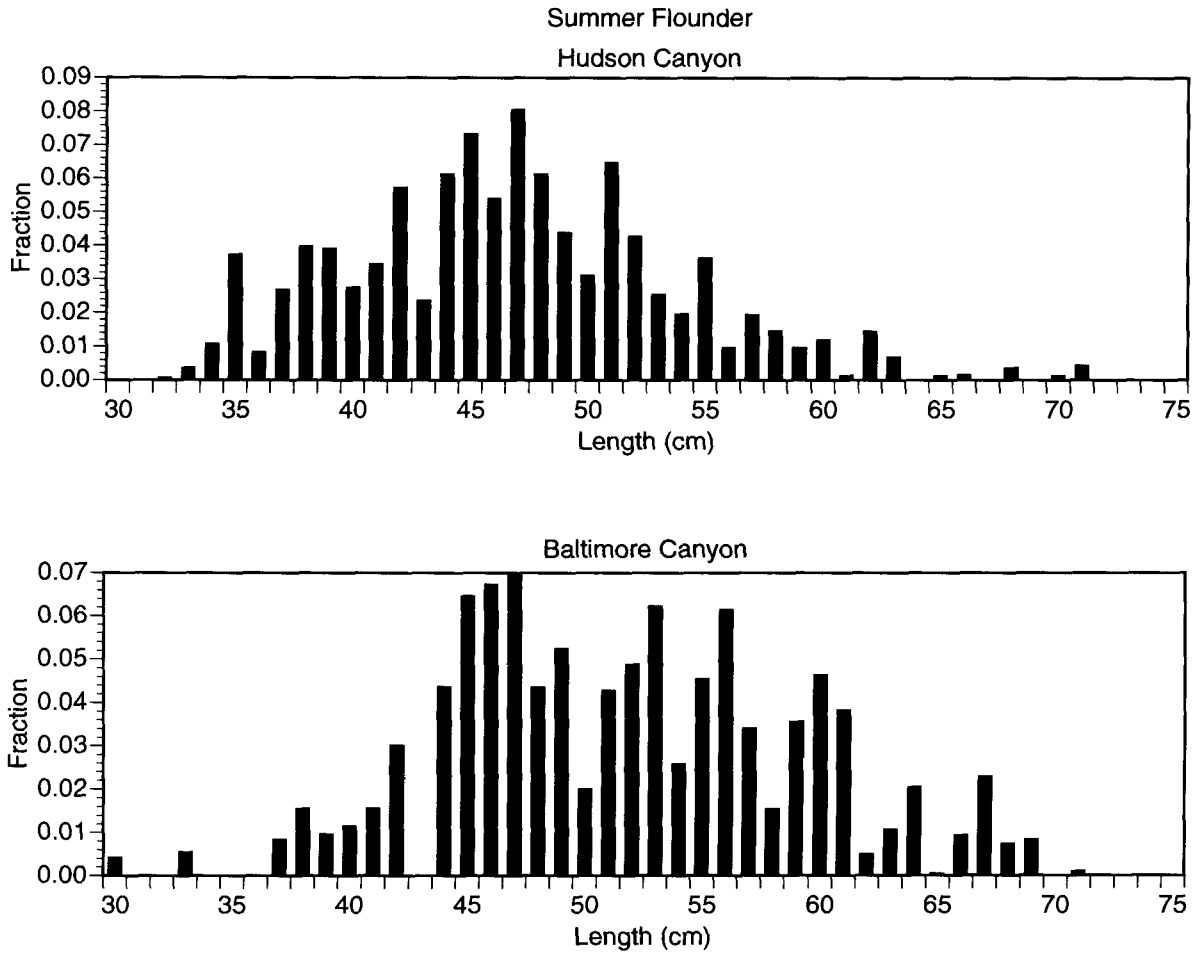


Figure 29. Cumulative size frequency, by tow, for black sea bass, for tows with ≥ 20 measured individuals.

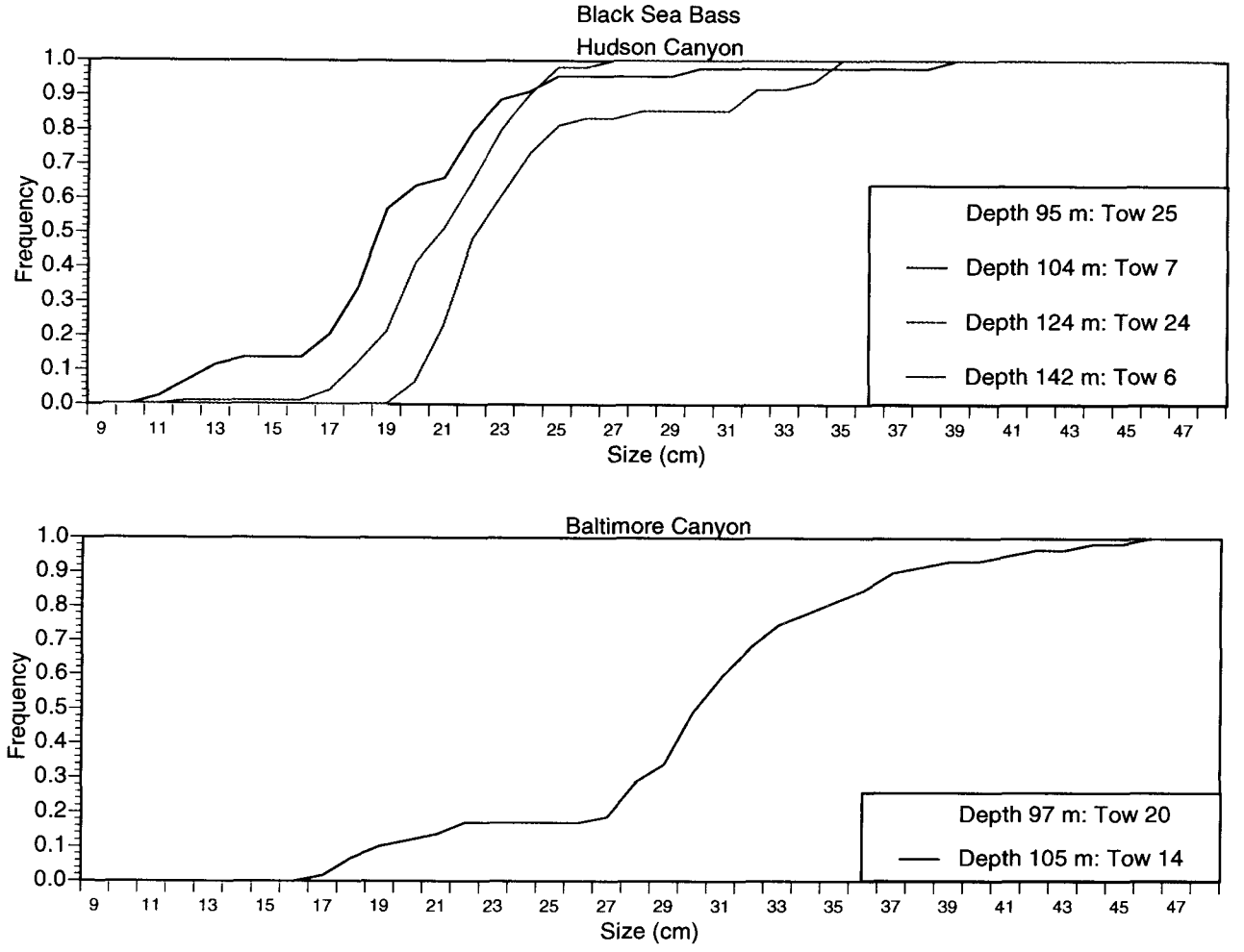


Figure 30. Cumulative size frequency, by tow, for *Loligo* squid, for tows with ≥ 20 measured individuals.

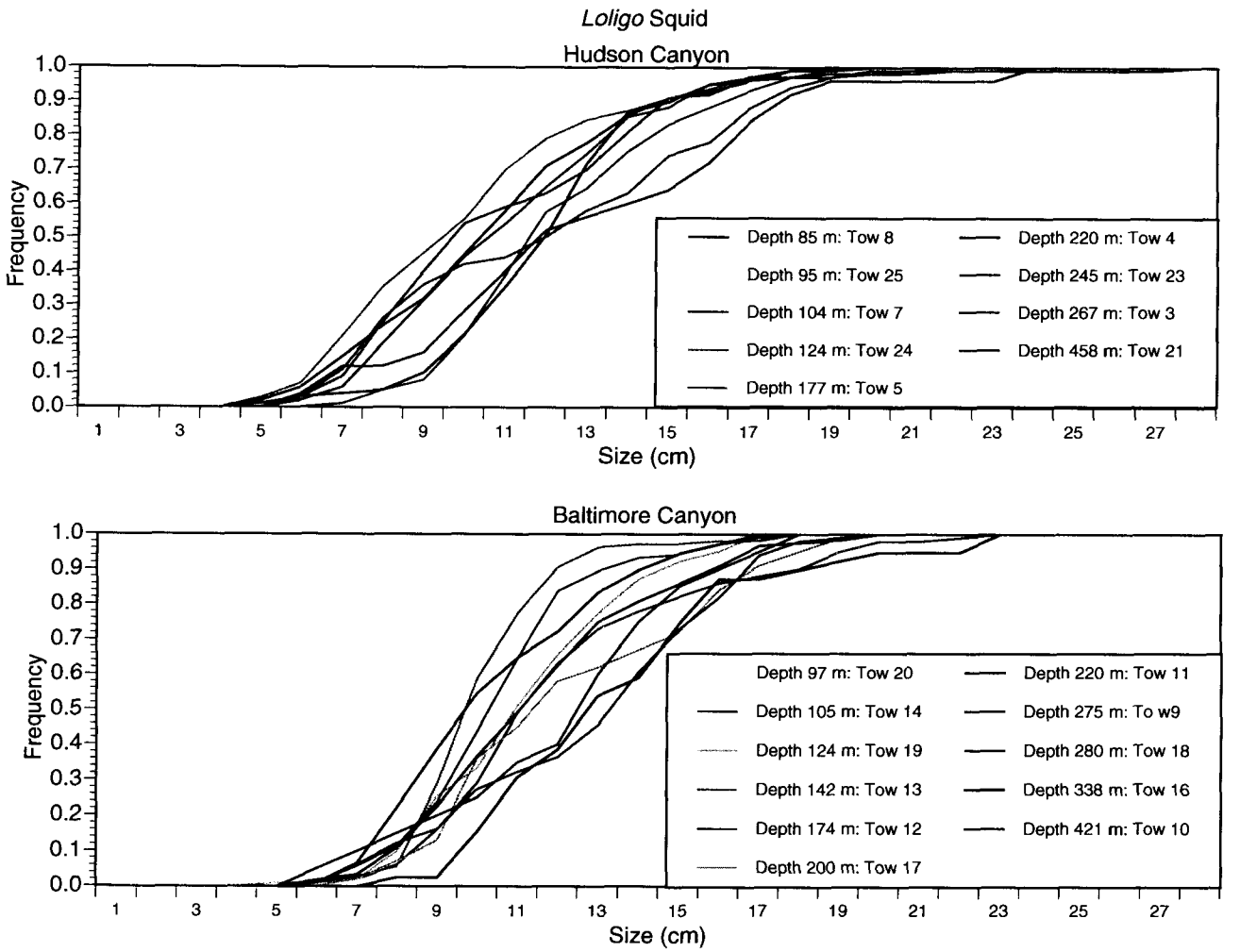


Figure 31. Cumulative size frequency, by tow, for monkfish, for tows with ≥ 20 measured individuals.

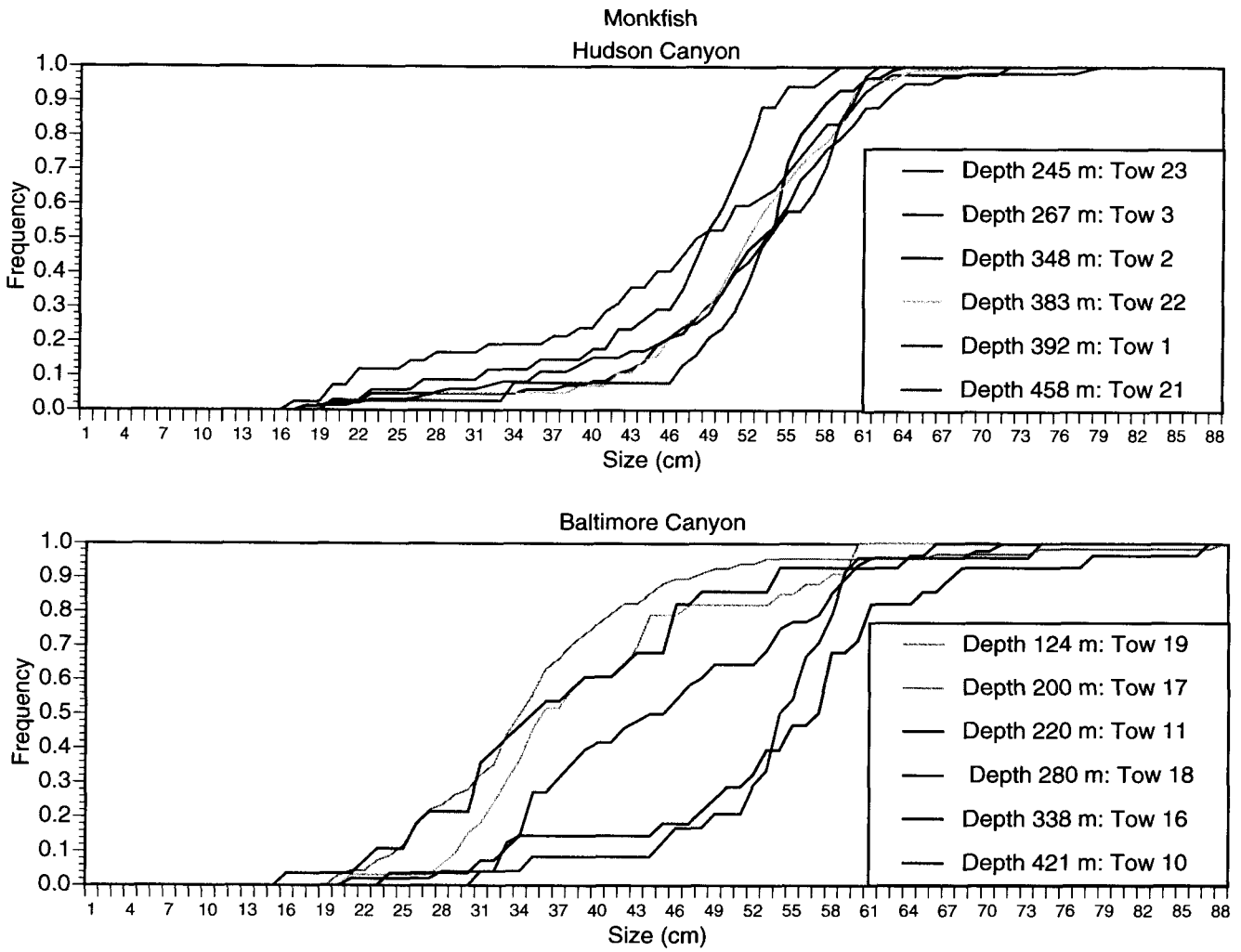


Figure 32. Cumulative size frequency, by tow, for scup, for tows with ≥ 20 measured individuals.

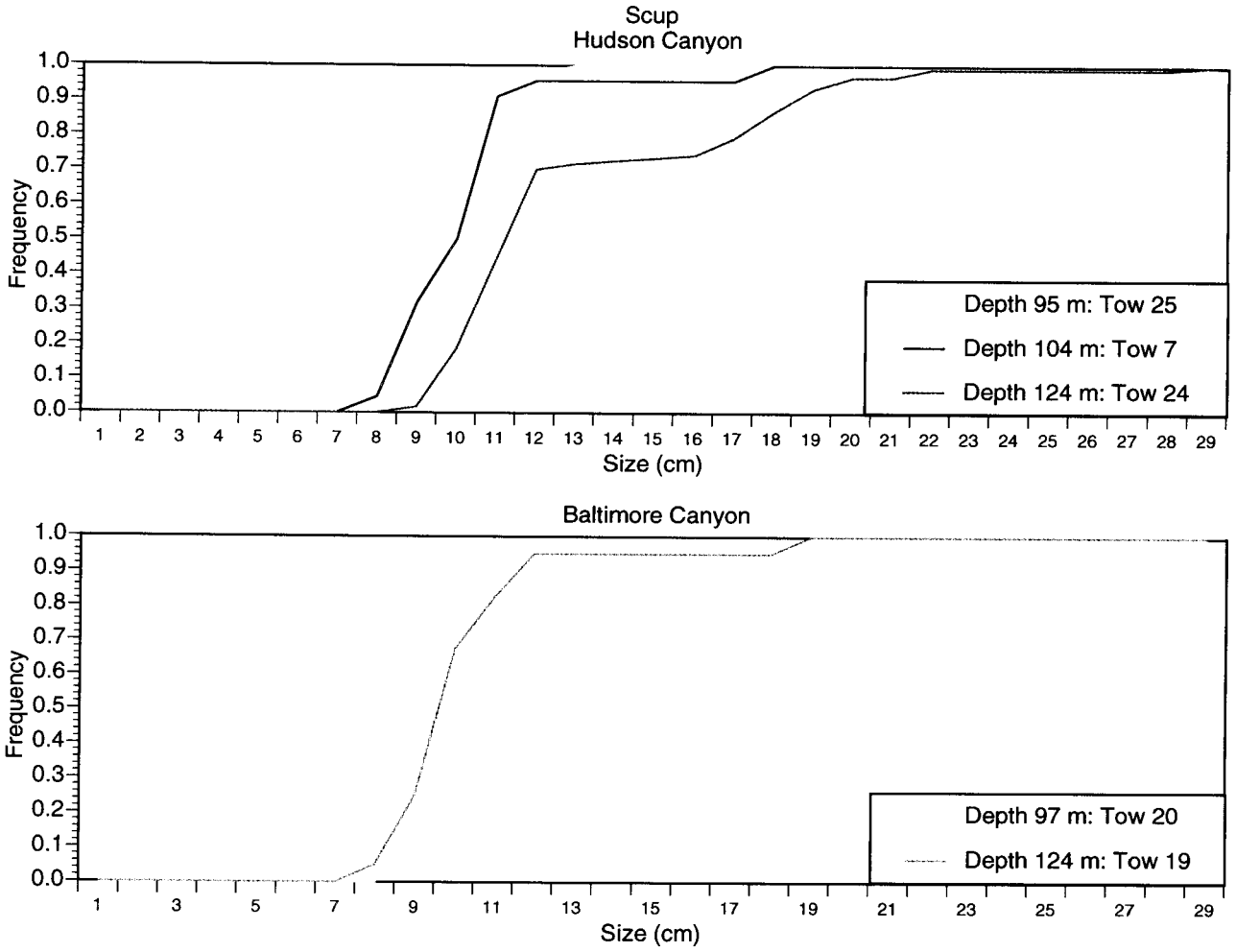


Figure 33. Cumulative size frequency, by tow, for spiny dogfish, for tows with ≥ 20 measured individuals.

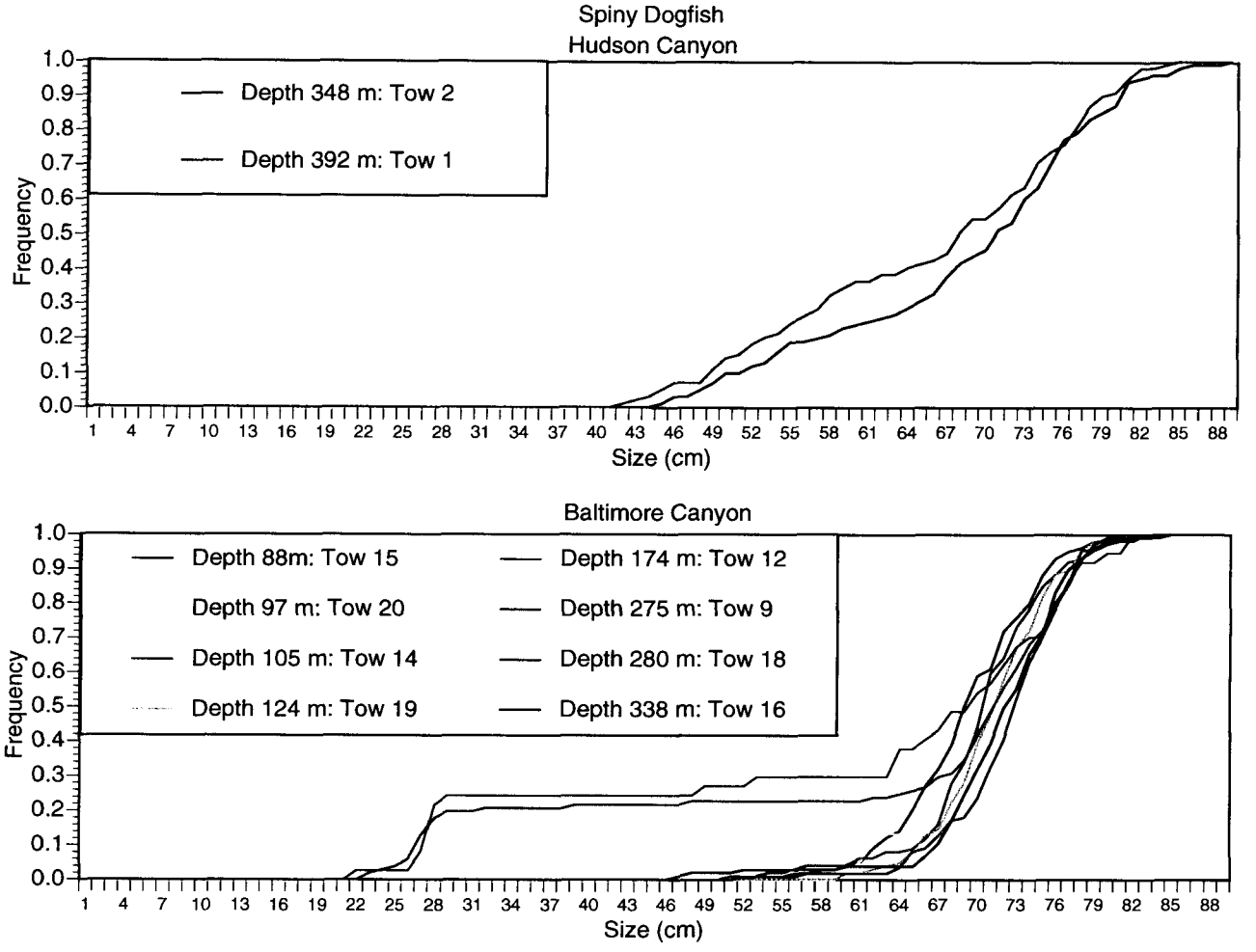


Figure 34. Cumulative size frequency, by tow, for summer flounder, for tows with ≥ 20 measured individuals.

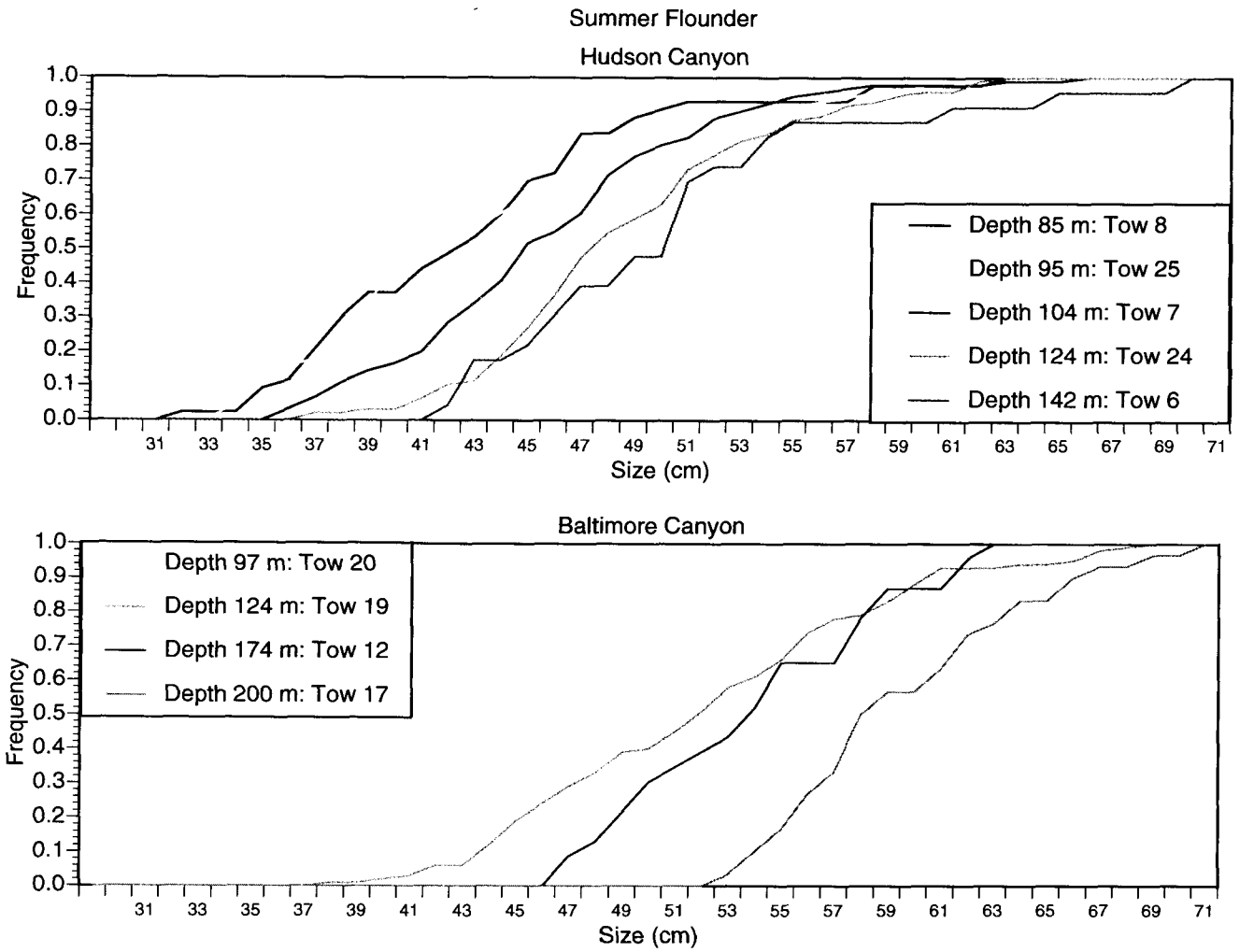
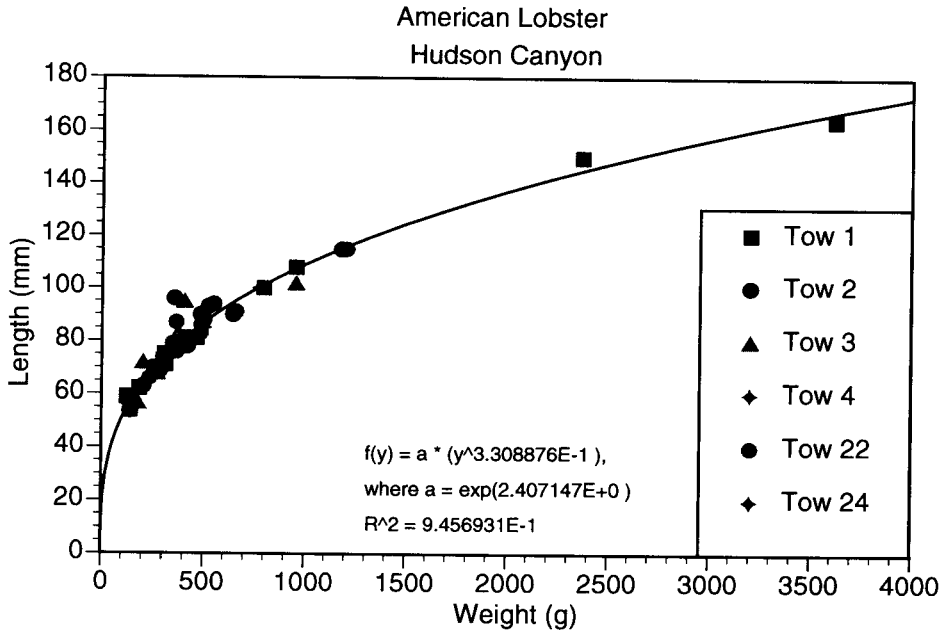


Figure 35. Relationship between length and weight for American lobster caught during March 2003. f(y)= length, y=weight.



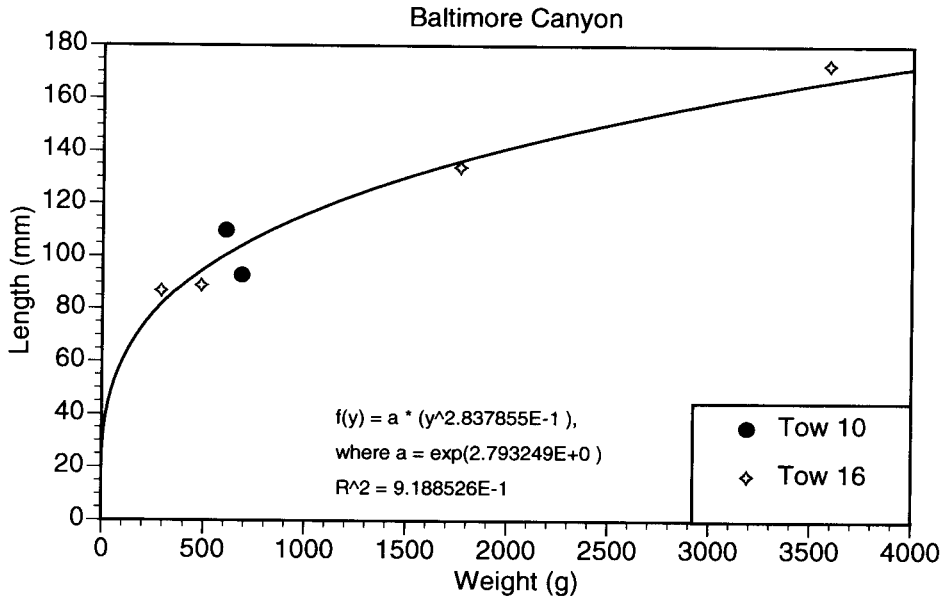
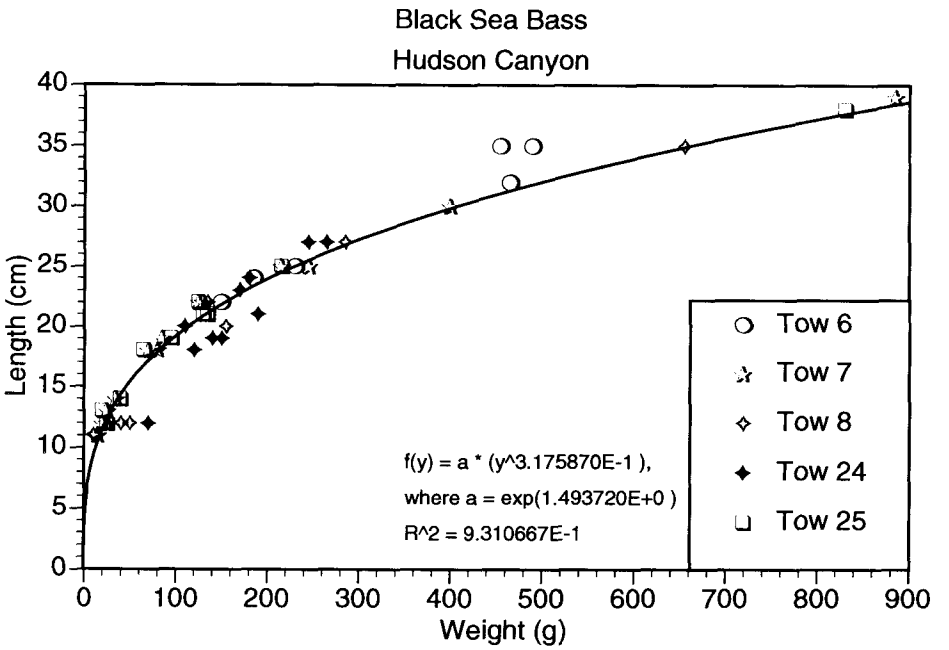


Figure 36. Relationship between length and weight for black sea bass caught during March 2003. f(y)= length, y= weight.



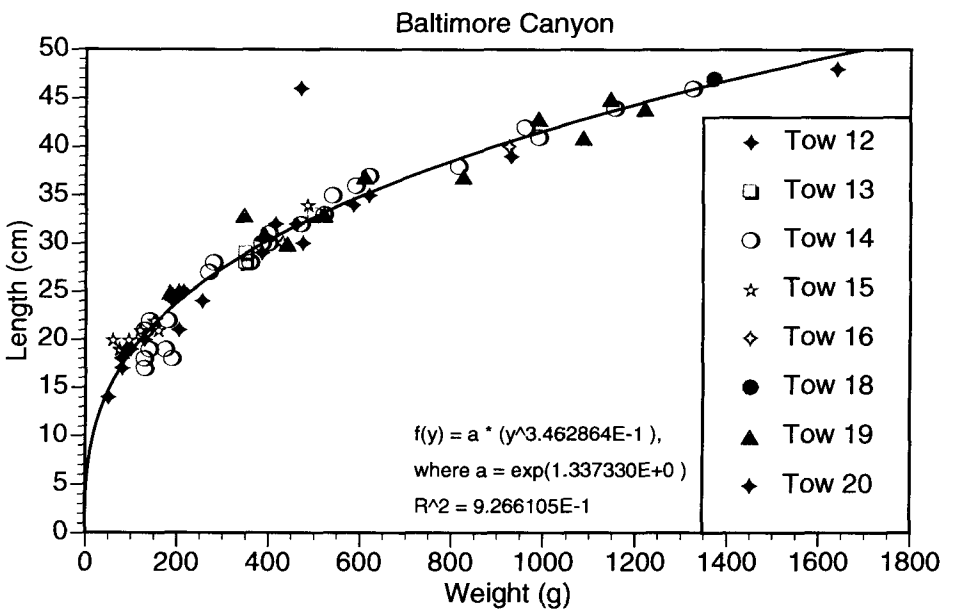
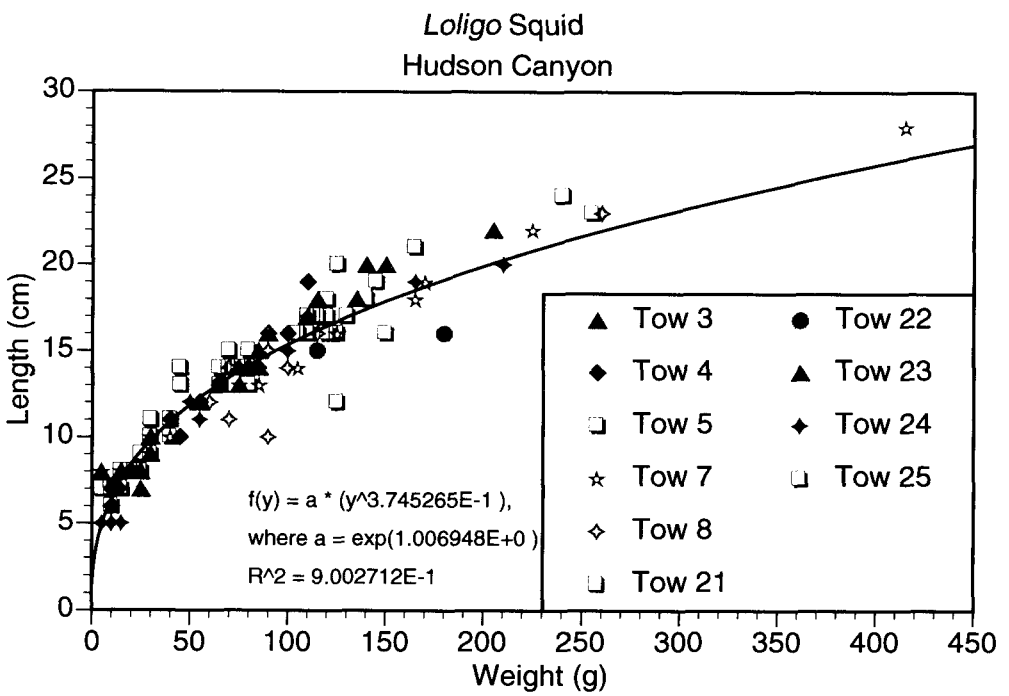


Figure 37. Relationship between length and weight for *Loligo* squid caught during march 2003. f(y)= length, y= weight.



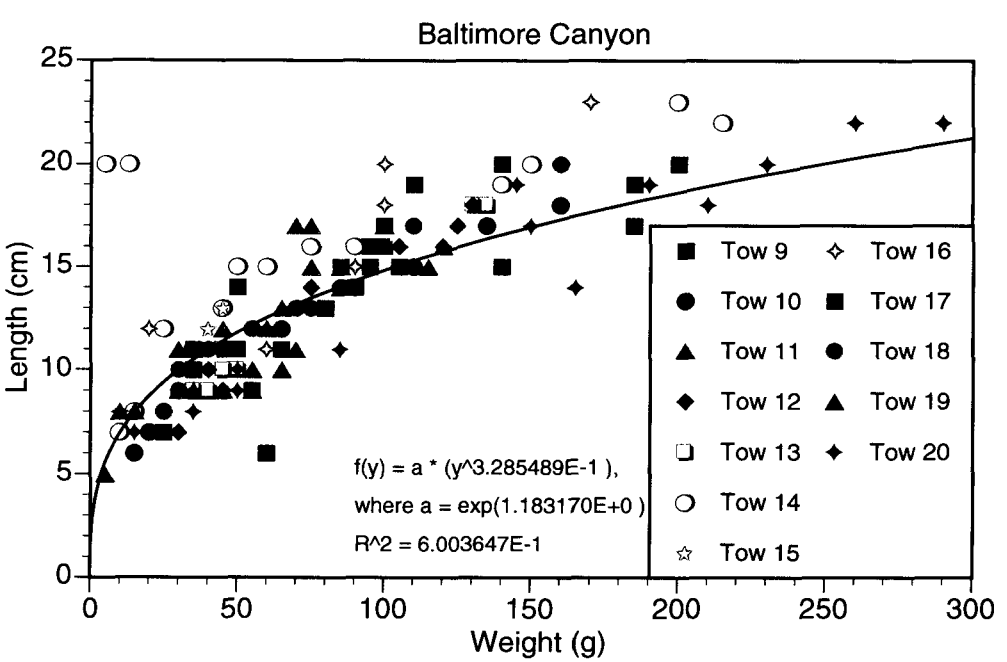
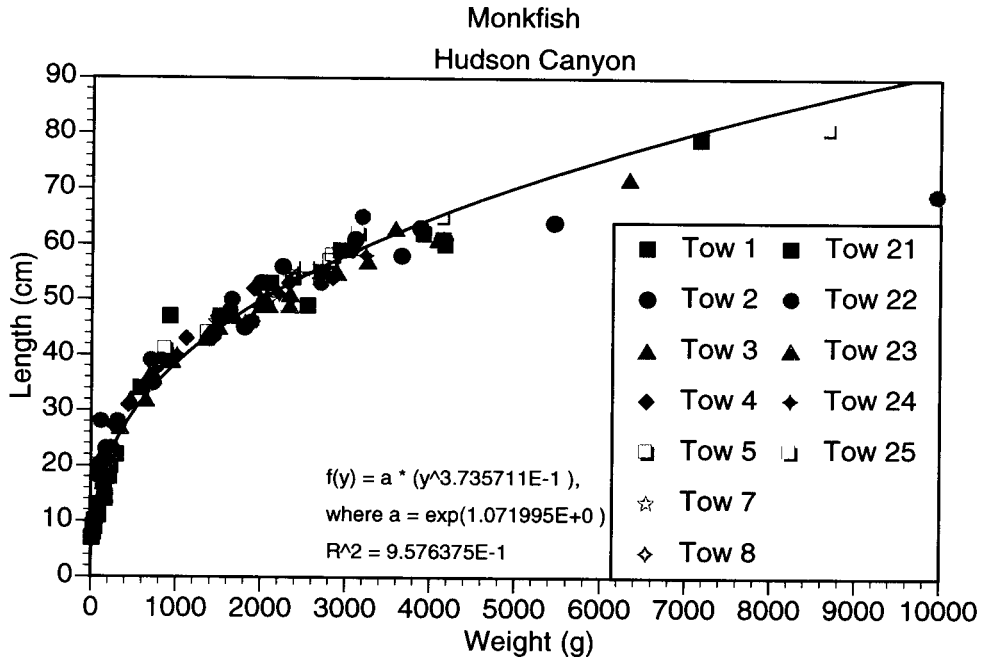


Figure 38. Relationship between length and weight for monkfish caught during march 2003. f(y)= length, y= weight.



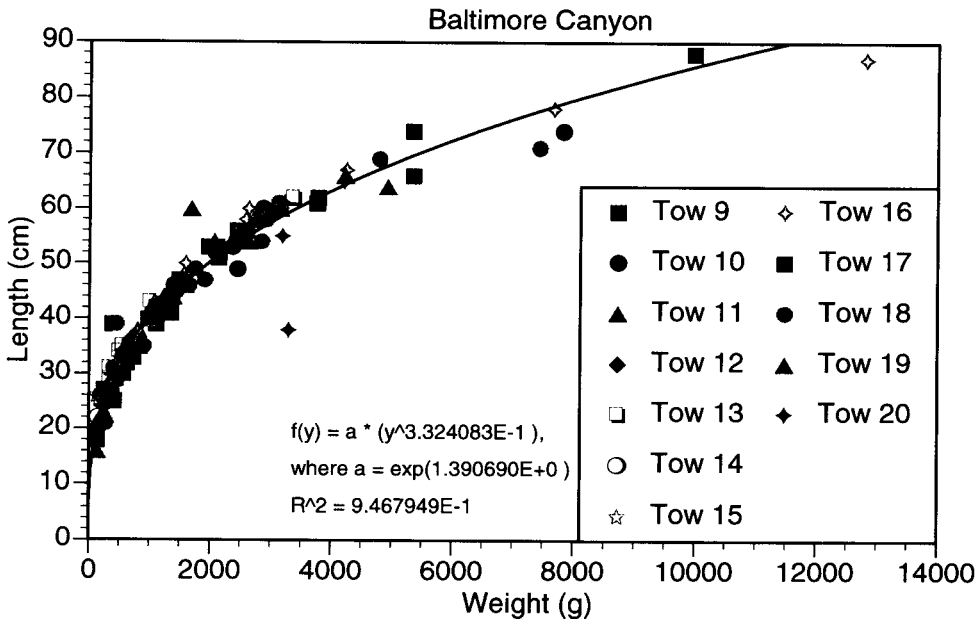
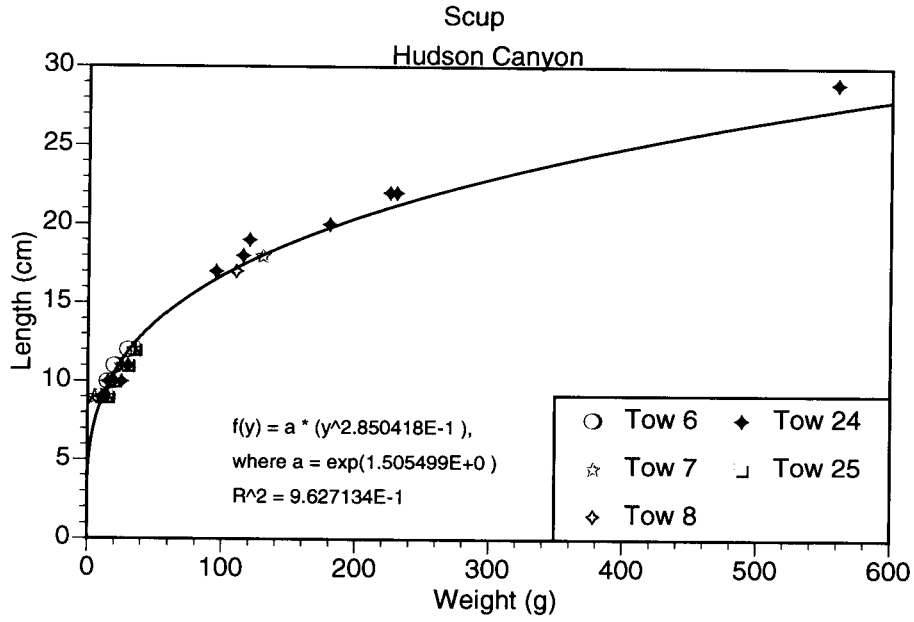


Figure 39. Relationship between length and weight for scup caught during March 2003. f(y)= length, y= weight.



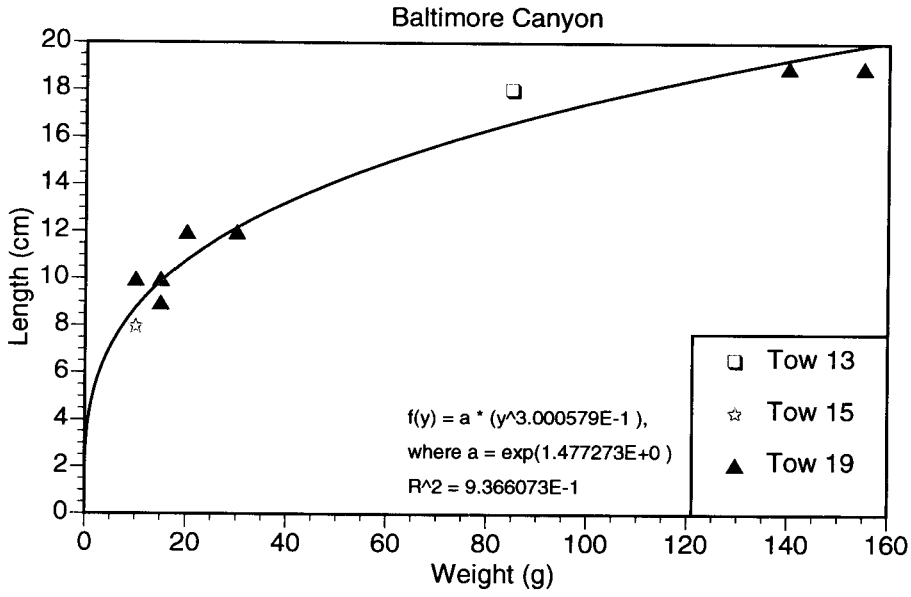
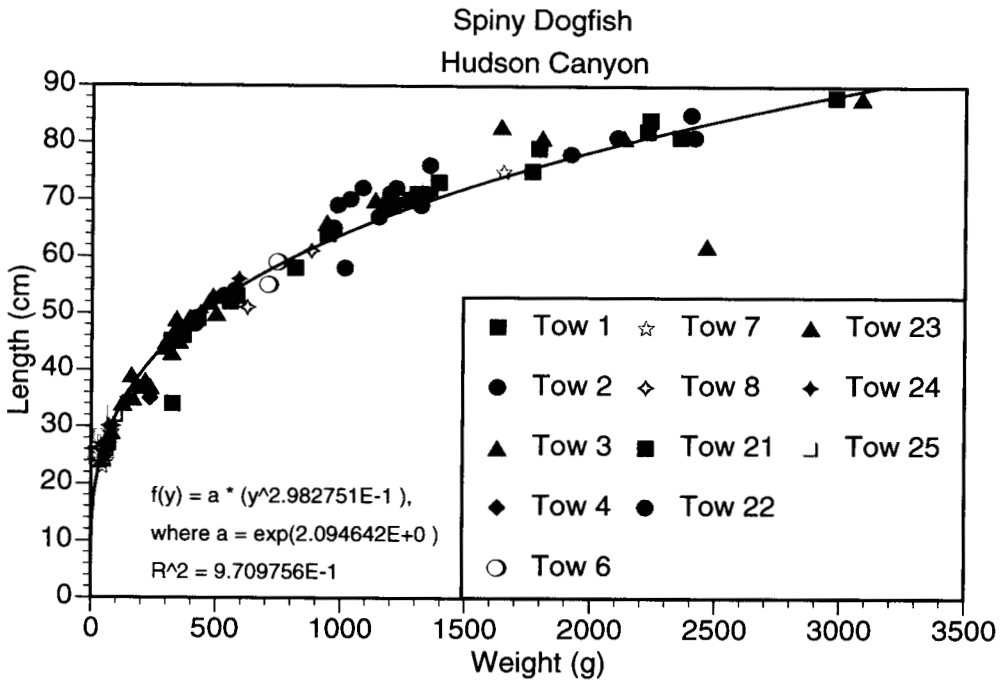


Figure 40. Relationship between length and weight for spiny dogfish caught during March 2003. f(y)= length, y= weight.



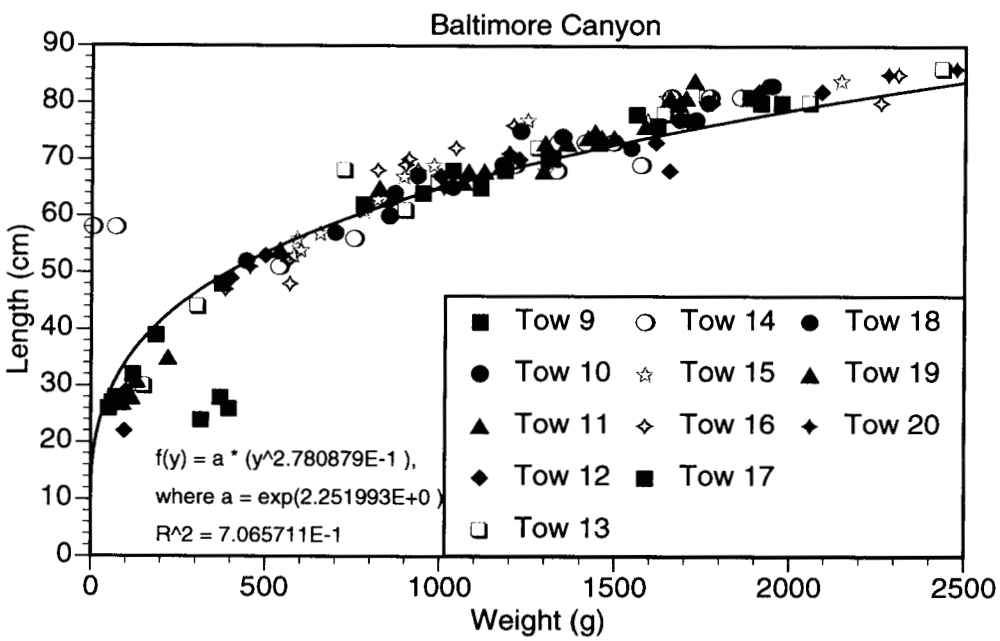
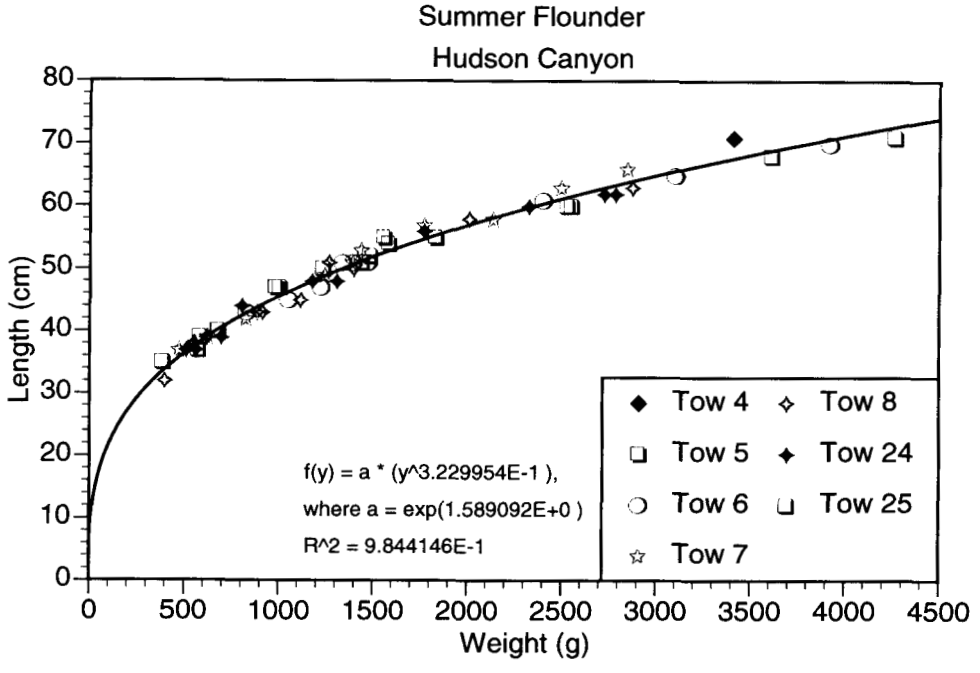
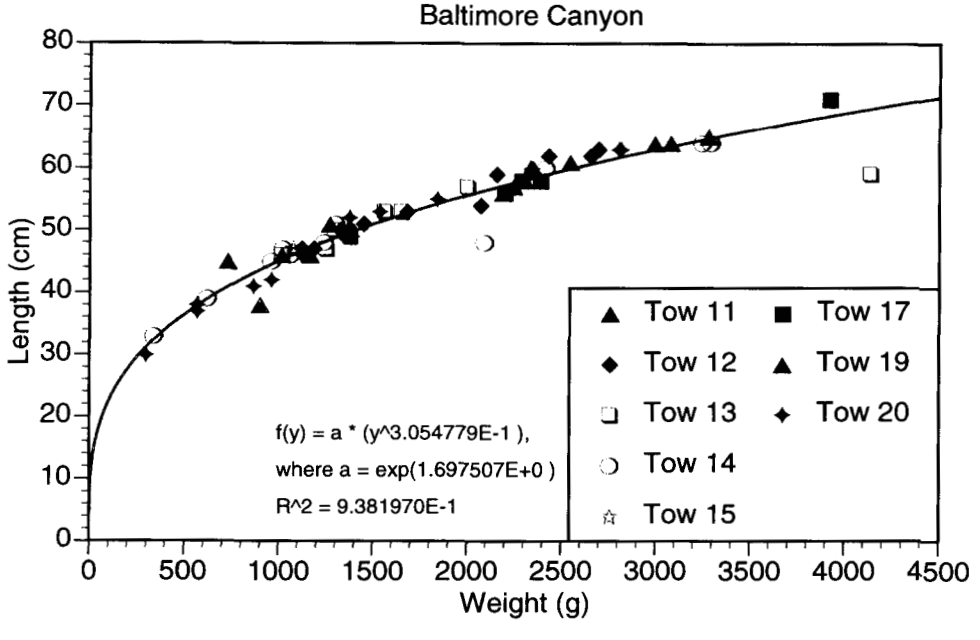



Figure 41. Relationship between length and weight for summer flounder caught in March 2003. f(y)= length, y= weight.