Cruise Report

R/V ENDEAVOR Cruise No. 263
Georges Bank Broad-Scale Survey for March 1995

US GLOBEC

NW ATLANTIC/GEORGES BANK STUDY

13 - 24 March 1995

Acknowledgements

We are grateful for the first rate seamanship and friendly company of the officers and crew of R/V ENDEAVOR, and for the fine support from the Marine Office at the University of Rhode Island. Captain Tyler and his crew made it possible to run the entire Broad Scale grid safely and with a minimum of struggle. Special thanks to David Nelson, URI marine technician, for a first rate job keeping our MOCNESS systems sampling.

ENDEAVOR No. 263 was sponsored by the National Oceanographic and Atmospheric Administration and the National Science Foundation. This report was prepared by Charles Miller, John Sibunka, Maria Bemis and Maureen Taylor.

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Purpose of the Cruise

ENDEAVOR-263 was the second of the U.S. GLOBEC Georges Bank Program Broad Scale Survey cruises. The goal was to occupy each of 38 stations spread around the bank in an anticlockwise pattern. Intentions of this program are thoroughly spelled out elsewhere. In brief, they are surveys of the distribution and abundance of fish larvae (with special attention to cod and haddock) and of their copepod food (with special attention to *Calanus finmarchicus* and *Pseudocalanus* spp.). Monthly timing of the cruises, alternating with Process Program cruises, is intended to allow tracking of larval patches and population development for both fish and copepods.

Scheduled work at each station was to lower a CTD to near the bottom, tow a bongo net (60 cm, 335 μm mesh) to near the bottom or a maximum of 200 meters, and tow a 1 m^2 MOCNESS to similar depths. Bongo hauls were primarily for fish larvae. The "MOC-1" was equipped with five 150 μm mesh nets (for copepod studies) and five 335 μm mesh nets (for ichthyoplankton studies). It was lowered and raised twice on each cast, taking complete profiles with each mesh size. In addition, at 18 "full" stations we collected a pump profile for naupliar copepods and other very small zooplankton, and we intended to tow a 3 mm mesh 10 m^2 MOCNESS sampler (4 nets). The MOC-10 was unwieldly aboard ENDEAVOR, and for safety reasons we could only deploy it in daytime when it caught virtually nothing. Therefore, we only towed it three times in fine weather. In addition to the station series, acoustic doppler current profiler (ACDP) data were gathered underway, and five drifters were deployed.

Thanks to fine weather and steady work on the part of all hands, we completed the 38 station grid with 54 hours left for (1) a larval fish survey in the vicinity of standard station 10 and (2) a transect across the northern edge of Georges Bank and out into the Gulf of Maine.

Chief Scientist's Report - Charles B. Miller, Oregon State University

We sailed exactly on schedule at 10:00 on 13 March and proceeded over the next 12 hours to GB-Broadscale Station 1. As shown in the event log we were able to run through the entire 38 station Broadscale grid (Figure 1) without dropping any stations. It was decided at the outset that only standard station numbers would be used, the secondary list of sequential station numbers would be skip numbers for stations not occupied. Because we occupied them all, this was not necessary. Completion of the grid was partly attributable to fine weather through most of the cruise, partly due to the careful and persistent work of the fine people in ENDEAVOR and in the Broadscale program scientific party. We did have some strong winds and high waves on the northeast peak and at Stn. 25 across NE Channel on the Nova Scotian shelf. A brief hailstorm in the same vicinity shut down work for about 20 minutes. However, because of the superb seakindliness of the ENDEAVOR, we were able to do bongo hauls and CTD's at all stations and MOC-1 sampling at all but three stations (all in NE sector: 25, 28,.29).

The cruise plan included fine-mesh pump and MOC-10 sampling at 18 so-called "full" stations. Pump profiles were obtained from all 18. The MOC-10 was hauled at only 3. I

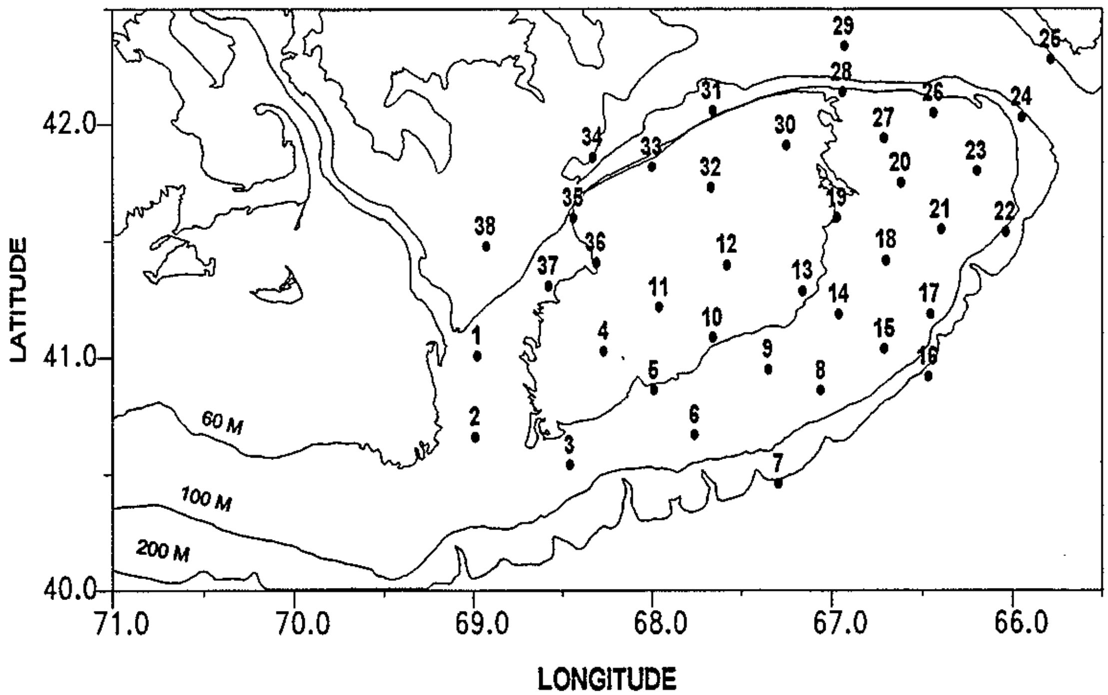


Figure 1. Stations occupied during the bank - wide survey, GLOBEC broad - scale cruise EN263

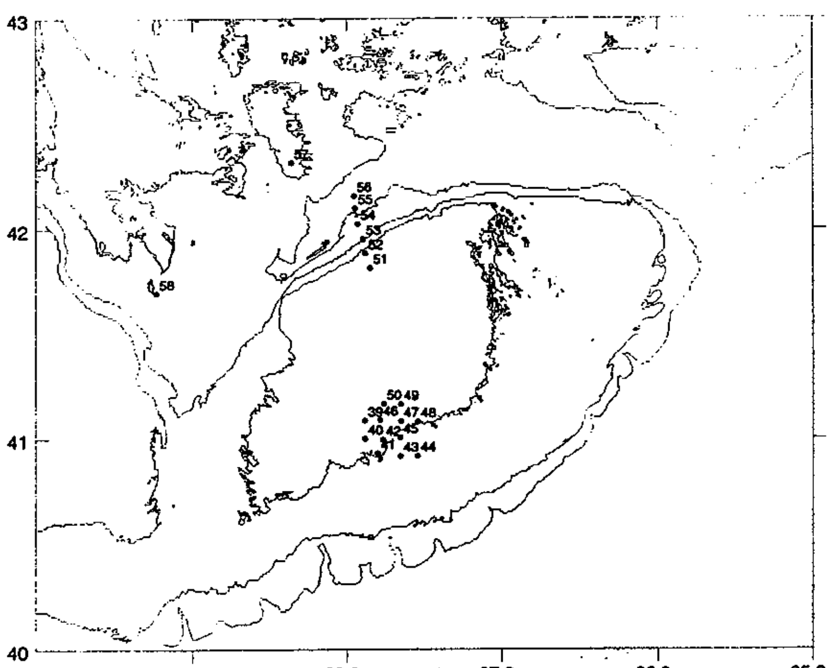


Figure 2. Station positions of post-Broadscale survey work done on ENDEAVOR No. 263. Stations 39-50 were a cod/haddock larval survey done with bongo nets at every station, MOC-1 at every other station. Stations 51 to 57 were a transect across the northern edge of Georges Bank and into the Gulf of Maine. At Station 58 we collected large numbers of *Calanus finmarchicus* for transport live to Narragansett for experimental work by Ann Durbin.

considered launch and recovery of MOC-10 overside from ENDEAVOR too dangerous and time consuming (3 to 4 hours per tow) to be carried out more than a very few times in fine weather in daytime. Furthermore, it caught virtually nothing. It was clear after the first haul that no value would come from more than a few MOC-10 hauls, and most were cancelled. Without doubt this decision enabled completion of the remainder of the program, leaving 54 hours at the end for two post-grid studies.

The first post-grid program was a 20 hour station pattern around Stn. 10, which was where we found the most gadid larvae (probably cod) on the initial survey. It is also close to the MARMAP mean position for cod larval concentrations in March. The 12 station plan was centered SW of Stn. 10 and run in a zig-zag pattern (Fig. 2) from west to east then north. The starburst station plan recommended by the larval fish group at Sandy Hook was deemed inappropriate by me, since we did not know exactly where the center of the cod dispersion pattern was located. A more evenly space-filling pattern was more appropriate and adopted. The initial plan for the grid was 12 bongo hauls with CTD attached on the towing wire, plus 6 MOC-1 hauls at odd numbered grid stations (39, 41, ...). The grid was begun at 1300 on 21 March. A train of 10-12 foot waves came across Georges Bank from the south as we ran through the pattern, causing us to drop MOC-1 tows at Stns. 43 and 45, replacing them with a second bongo haul for use in the NOAA larval biochemistry program. By Stn. 47, exactly at the position of Broadscale Stn. 10, the waves had passed and MOC-1's were obtained at 47 and 49.

The second post-grid program was a transect (Fig. 2) of 6 stations across the northern perimeter of the bank, approximately along 67°55'W (tending slightly west of due north). The objectives were (1) to replace the deep Gulf of Maine MOC-1 cast lost at Stn. 29, (2) to delineate hydrographically the northern limb of the Georges Bank peripheral current, and (3) to study the relationship between that hydrography and the gradient in zooplankton species composition from mostly *Calanus finmarchicus* in the Gulf of Maine to mixed *Calanus* and *Centropages* (both *hamatus* and, less abundant, *typicus*) stocks over Georges Bank. That transect was completed in good, sunny weather and we added a station two hours steam to the northeast in Rogers Basin. That, too, went smoothly.

A final station was staged in the "SCOPEX area" north of Great South Channel to collect *Calanus*-rich live plankton samples for Mackeral feeding experiments in progress at Ann Durbin's laboratory, URI. All of the post-grid work was planned for 47 of the available 54 hours before needing to turn the ship over to the crew for return home from Great South Channel at 1400 on the 23rd. We finished ahead of 47 hours, and even with 4 more added hours for the Rogers Basin station we had completed the "meat haul" for Dr. Durbin by 0900 on the 23rd. The more I laid on, the faster the work seemed to go; time expanded to hold more and more. I finally gave in to this phenomenon and ENDEAVOR tore home arriving 18:45 on the 23rd.

All personnel on ENDEAVOR #263 performed very well. The crew cordially welcomed us aboard their ship and supported the scientific work professionally in all respects. Bridge watches were attentive. Machinery ran with only one minor hitch, which was promptly repaired (<u>all</u> engineers turn out to fix a problem, regardless of the hour). Winchmen were skillful and careful. The food was good and plentiful. The scientific party, mostly young technicians, were well prepared by experience provided on the November ALBATROSS IV cruise and for some of them on ENDEAVOR #261 in February. They worked steadily and cheerfully through 10 days with 12 hours on watch (8 on, 4 off, 4 on, 8 off). Toward the end they were getting a little silly, but older hands damped this enough that it wasn't dangerous. Dave Nelson, URI marine technician, gave us excellent support, especially with MOCNESS repairs. The only significant mishap was a serious cut in Dave's hand sustained while using the drill press in the engine room. Dave allowed Captain Tyler, who is not exactly a plastic surgeon, to stitch the wound rather than insist on a more reasonable return to shore for treatment. I left that decision to the Captain and Dave. The watch leaders, John Sibunka and I, shared leadership of the scientific party about equally. It was a pleasure to work with him. I slept well with the deck in his competent hands. Nothing by way of preparation or planning was forgotten, mostly due to John's intense determination to get things right. Finally, everyone seems to have had an enjoyable cruise. There were lots of good times and strong camaraderie developed, particularly within watches. My thanks to everyone for the hard, uncomplaining work and strict attention to safe procedures. Congratulations team on getting it all done.

Due to discrepancies in impressions of zooplankton abundance, no elaborate figures characterizing regional variation in stocks are provided as has been done in some Georges Bank cruise reports. For ENDEAVOR #263 such charts should await full sample processing.

Scientific Summary: Charles B. Miller

Waters over Georges Bank were close to 5° C bank-wide, with a patch of colder (<4° C) water to the northeast where the Nova Scotian shelf current was sliding directly across NE Channel on to the SE sector of the bank. This cold injection was evident in satellite thermal imagery supplied by Jim Bisagni at sailing. The imagery also showed warm rings moving along the south slope, and we found patches of water up to 10°C at our more southerly stations, particularly to the east. The only stratification observed throughout the cruise was intrusion near the seafloor of warmer, more saline slope water south of the 60 meter contour. There were also signs of slope water intrusion over the steeper slope along the northern perimeter of the bank. A more detailed preliminary report is provided here by Maureen Taylor.

Chlorophyll fluorescence was patchily distributed across the bank, with consistently high values along the southern side of the eastern end of the bank. Similar patchiness was observed in net phytoplankton captured by the zooplankton samplers (150 and 333 μm mesh). There was a bloom of large (200 μm) *Coscinodiscus* spp. in progress all over the bank, but very patchy in intensity. They were consistently present in the SE sector, combining there but only there with large numbers of *Rhizosolenia*. The two-species bloom in the SE sector coincided with the intrusion of Nova Scotian shelf water. Extracted chlorophyll levels (18 stations) were not extraordinarily high, maximum of 1.5 mg m^{-3}, and usually lower, but most of it was found in larger size fractions (> 20 μm). Thus, there probably is some correspondence between the patchy pattern of chlorophyll fluorescence and the pattern of the diatom blooms. Quantities of net phytoplankton and chlorophyll both fell off sharply to the south and north of the bank. The bank clearly provides the restriction of mixing to within the euphotic zone required to sustain phytoplankton population increase.

Copepod numbers and biomass were dominated throughout the region sampled by *Calanus finmarchicus*. The stock in most places was remarkably old, with large numbers of males, females and C5's. Fourth copepodites were present most places, but usually fewer than C5's, and C3's were few. At a few stations right over the bank there were younger stocks with large numbers of C1-C4, but that was not the general rule. Reports of active reproduction from the January process cruise and from the early March process cruise of dominance in the *Calanus* population of C3 and C4 suggests that *Calanus* got an early start in 1995 and has completed its G1 generation already. Many of the females had full oviducts, and our pump samples showed the presence of *Calanus* nauplii at most bank sites. It seems likely that a G2 generation has already started. The fairly wild variation in stage composition between stations is likely to make precise reconstruction of the reproductive and development schedules for 1995 difficult to do with certainty.

Extensive examination by me of lipid quantities in *Calanus* C5 at 14 stations showed a strong difference between bank stations, where most specimens had an oil content equal to ca. 30% of body weight, and Gulf of Maine stations, where oil sacs were very slender suggesting lipid weights of ca. 5-10%. The larger quantities at bank stations were not, however, nearly so large (>50% of body weight) as seen in C5 prepared for the rest phase in late spring. Feeding was obviously more intense in bank specimens, the guts of which were packed solid with green material, while guts in the Gulf were very pale green at best. It will be useful to examine bank specimen gut content for *Coscinodiscus* frustule shards to determine whether they are eating the apparently dominant cells in the bloom. A visual comparison of a 200 μm cell with copepdites, particularly C3's and C4's, suggests some difficulty for ingestion.

Other copepod species were present, particularly *Centropages hamatus* and *Centropages typicus* over the bank. The relative abundance of the two varied from site to site. *Centropages hamatus* was the most abundant species at stations 1 and 2 on the west side of Great South Channel, while *C. typicus* was present at scattered stations across the grid, usually joined by a few specimens of *Temora*. Stations in the Gulf of Maine had very few specimens of species other than *Calanus*, all of which appeared in significant numbers mostly over the bank proper. *Pseudocalanus* spp. were present everywhere, more over the bank than elsewhere, but never impressively abundant. The same was true of *Oithona similis*.

Also abundant in plankton hauls were chaetognaths, *Sagitta* sp. They were mostly seen over the bank and along the south flank. The *Clytia* (pelagic hydroid) population seen so prominenty in spring 1994 cruises over the bank was very reduced, making up <1% (by guess) of biomass. However, they were definitely present at most stations over the bank where they were specifically sought. Given their likely high growth potential, I predict that they will again be a major component of shallow area zooplankton by late spring. Further characterization of the zooplankton is provided by Maria Bemis in her report included here. Readers will find we do not agree about the relative abundance of *Calanus* copepodite stages or the abundance of chaetognaths. These discrepancies are caused by the cursory, first impression character of our sample evaluations. These matters will be settled by counting the samples.

Fish larvae were abundant in many of our bongo hauls, few in the MOCNESS samples, particularly along the south flank. The most abundant larvae over the entire region were of herring and sand lance. John Sibunka reports preliminary observations on ichthyoplankton in his section of this report. There were gadid larvae at stations in the middle of the south flank (centered at Stn. 10), which is the mean position of the cod and haddock larvae patches in March MARMAP data. On this basis we placed a 12 station post-Broadscale Survey sampling pattern in the vicinity of Stn. 10.

Hydrography - Maureen Taylor and Dan Almgren

Objectives: The objective of the hydrographic sampling on the broad scale survey cruises is to characterize the physical environment within which the target organisms reside. Of particular interest is the seasonal development of thermal and density stratification of the Georges Bank waters. The temperature and salinity data can also give an indication of the source of the waters on the Bank: Gulf of Maine, Scotian Shelf, and Slope water.

Operations: The primary hydrographic data presented here were collected using a Neil Brown Mark V CTD instrument (MK5), which provides measurements of pressure, temperature, conductivity, and fluorescence. The MK5 records at a rate of 16 observations per second, and is equipped with a rosette for collecting water samples at selected depths.

A Seabird Electronics Seacat model 19 profiling instrument (SBE19 Profiler) was used on each bongo tow to provide depth information during the tow. Pressure, temperature, and salinity observations are recorded twice per second by the Profiler. The Profiler was also deployed during pump operations, again to provide depth information. The MOCNESS systems (MOC-1 and MOC-10) are both equipped with their own environmental sensing systems to measure pressure, temperature, salinity and fluorescence (MOC-1 only) at 4 second intervals during the tow. On stations where weather did not allow for the deployment of the MOC-1, a second bongo haul was made, again using the Profiler to provide depth information. The MK5 was not used during the cod/haddock larvae grid but was deployed during the northern transect into Franklin Basin.

The following is a list of the CTD data collected with each of the sampling systems used on the cruise:

Instrument	**# Casts**
MK5	45
SBE19/Bongo	56
SBE19/Pump	18
SBE19 calibration	5

The MK5 was deployed with 6 bottles on the rosette and samples were collected for various investigators. On each MK5 cast, samples were collected for oxygen isotope analysis at selected depths for R. Houghton (LDGO) and a sample was taken at the bottom for calibrating the instrument's conductivity data. On stations which included pump operations, rosette samples for nutrient analysis were collected at selected depths for J. Bisagni and J. O'Reilly (NMFS), and samples for chlorophyll analysis were collected from the bottom, 20 meters, and surface. Chlorophyll samples (three, 50 ml replicates) were filtered for three size fractions: total, < 20 microns, and < 5 microns. Total chlorophyll filtration results were also used for comparing the data from the MK5 fluorometer. Also, on pump stations, surface samples for phytoplankton species composition were collected for J. O'Reilly (NMFS). The chlorophyll analysis was conducted at sea using an acetone extraction method and results were read 24 hours later on a calibrated fluorometer.

Parameter	**# samples taken**
MK5 calibration	35
Oxygen isotope	132
Nutrients	76
Chlorophyll	153
Species composition	17

Data: The MK5 and SBE19 Profiler performed very well on the cruise. Only on one station (#11) there were problems with the Niskin bottles being tripped on the rosette. No water samples were taken for cast #11 because it could not be determined at what depth each bottle had actually been tripped.

The SBE19 Profiler and MK5 data were post-processed at sea. The Profiler data were processed using the Seabird manufactured software: DATCNV, ALIGNCTD, BINAVG, DERIVE, ASCIIOUT to produce 1 decibar averaged ascii files. The raw MK5 data files were processed using the manufacturer's software CTDPOST in order to identify bad data scans by "first differencing." The latter program flags data where the difference between sequential scans of each variable exceed some preset limit. The "Smart Editor" within CTDPOST was then used to interpolate over the flagged values. The cleaned raw data were converted into pressure averaged, pressure centered 1 decibar files using algorithms provided by R. Millard of WHOI, which had been adapted for use with the MK5.

The data presented here are from the MK5 CTD system. Figure 1 shows the station locations (1 - 38 only) occupied during the bank - wide survey. The surface and bottom temperature and salinity distributions are shown in Figures 3 - 4. Surface and bottom anomalies of temperature and salinity as well as a stratification index (surface to 30 meters) were calculated using the NMFS MARMAP hydrographic data set as a reference. The anomaly distributions are shown in figures 5 - 7. Profiles of each MK5 CTD cast with a compressed listing of the data are available from Dr. David Mountain, NOAA/NMFS/Woods Hole.

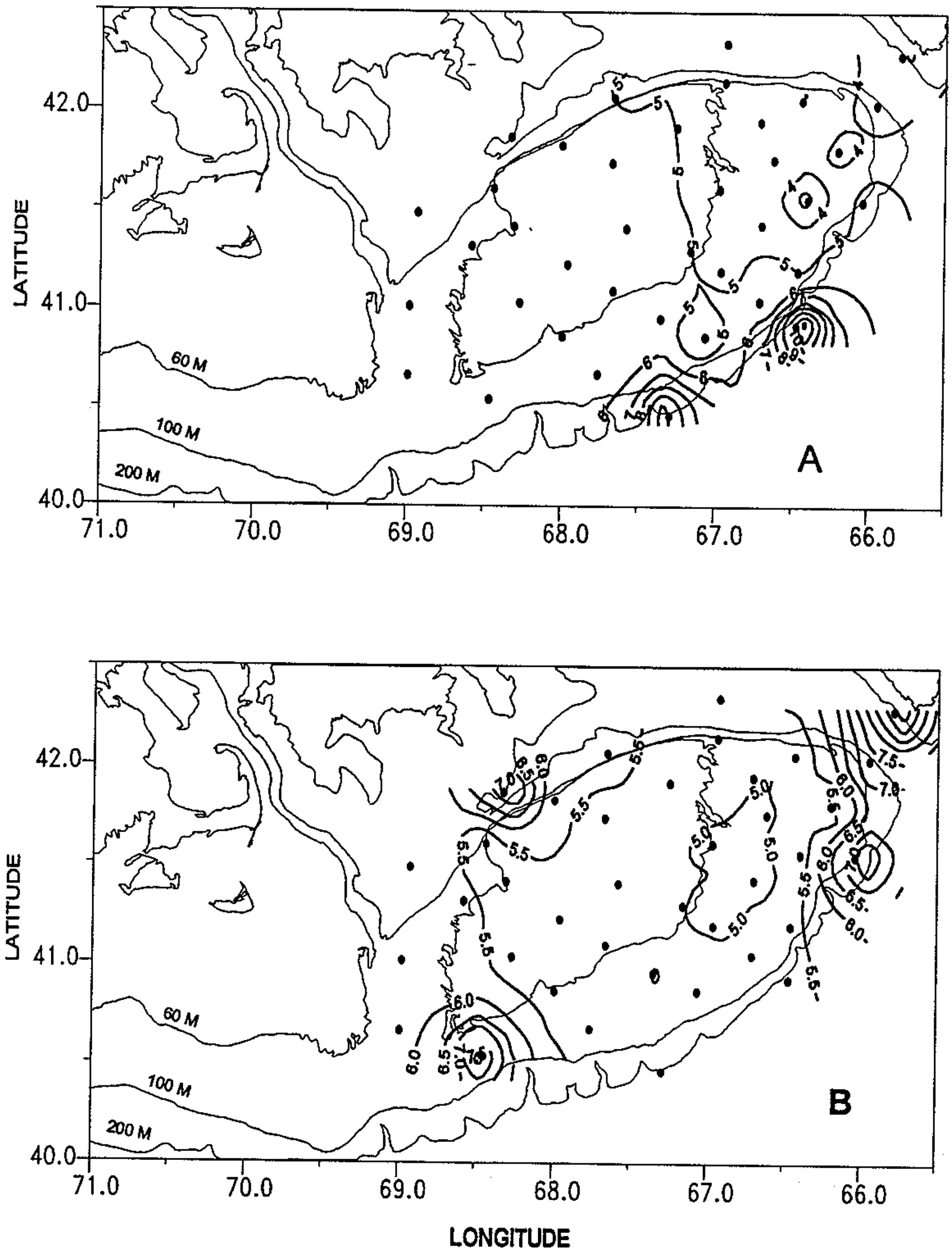


Figure 3. Surface (A) and bottom (B) temperature distribution from broad - scale survey EN263

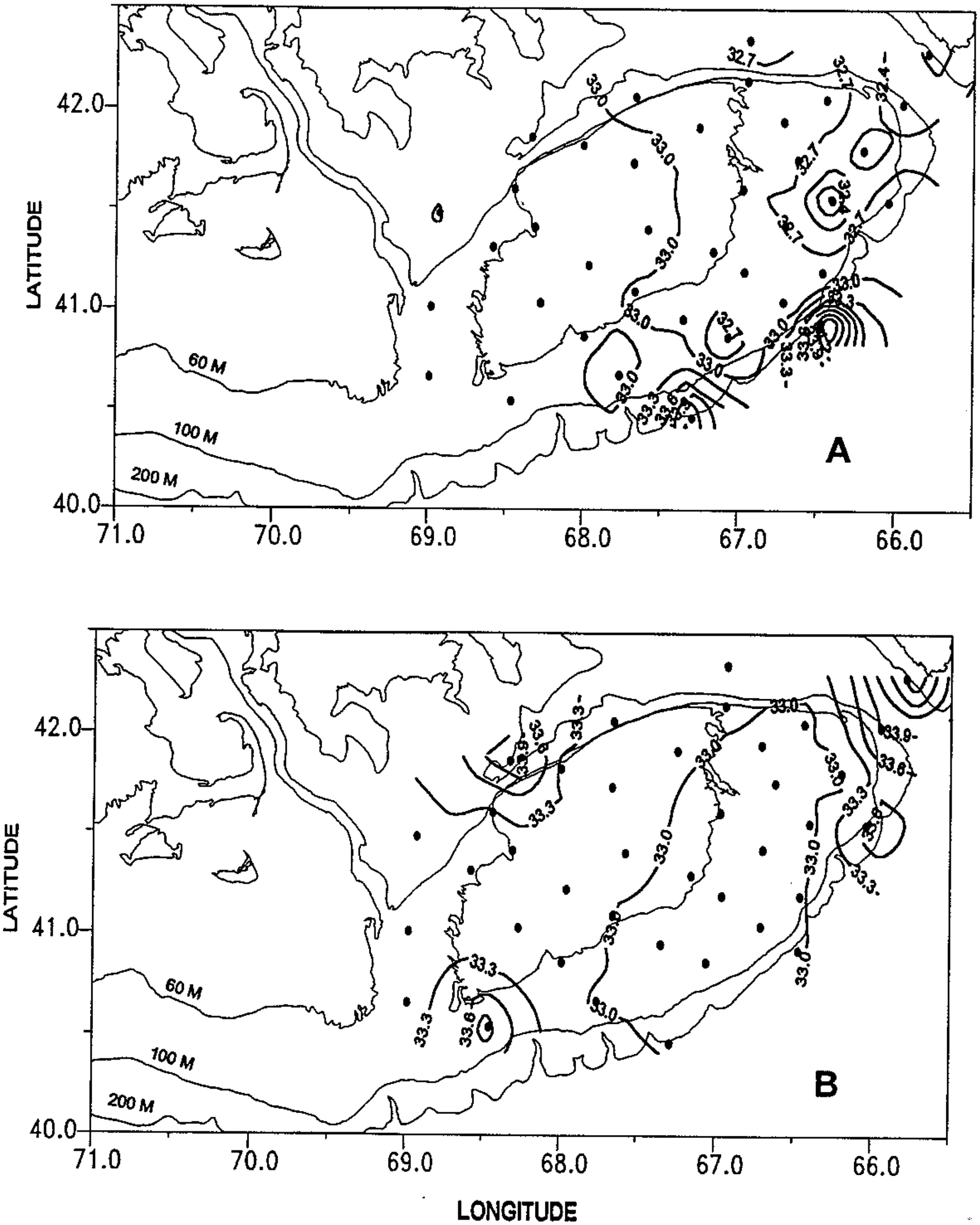


Figure 4. Surface (A) and bottom (B) salinity distribution (psu) from broad - scale survey EN263

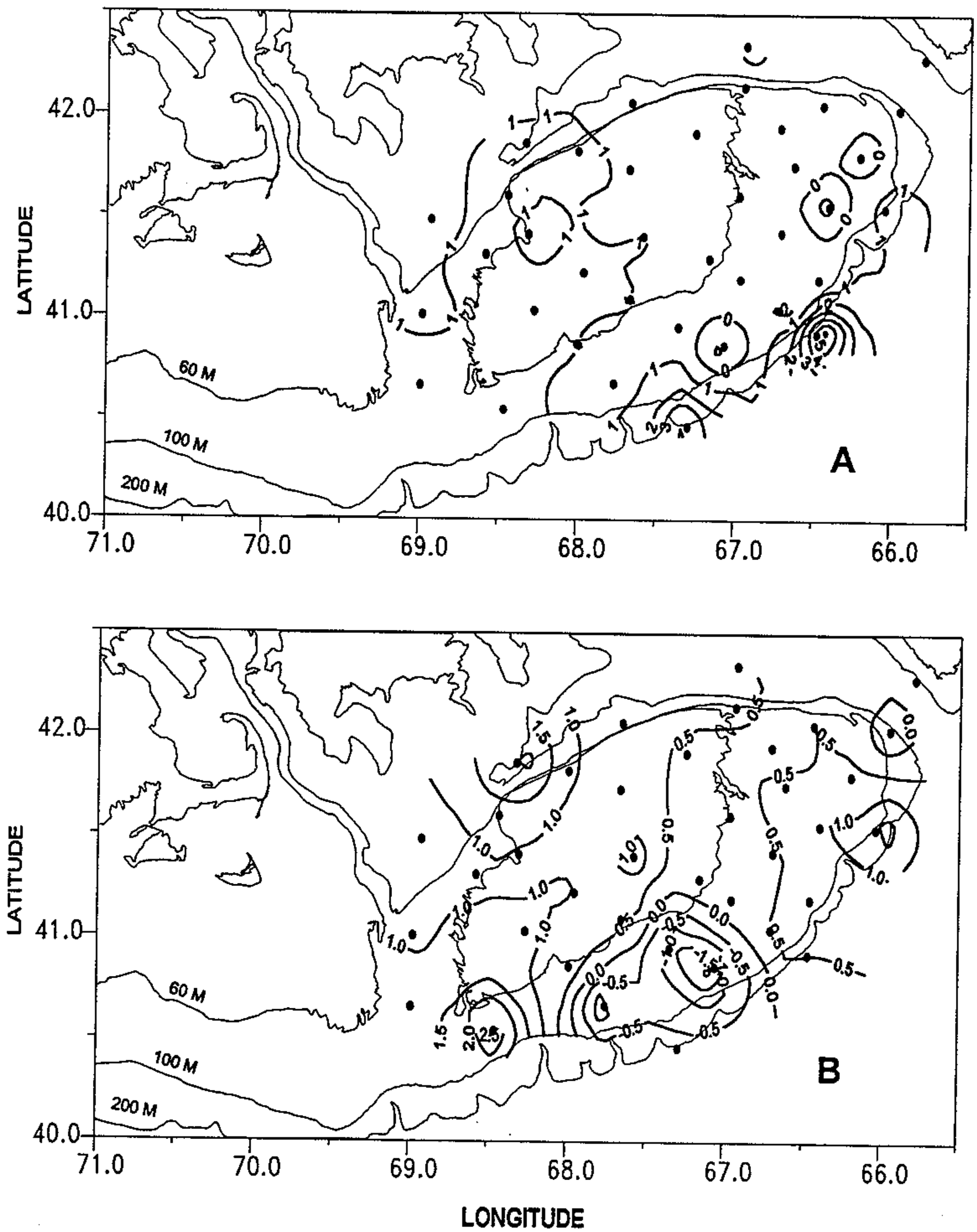


Figure 5. Surface (A) and bottom (B) temperature anomaly distributions during broad - scale survey EN263.

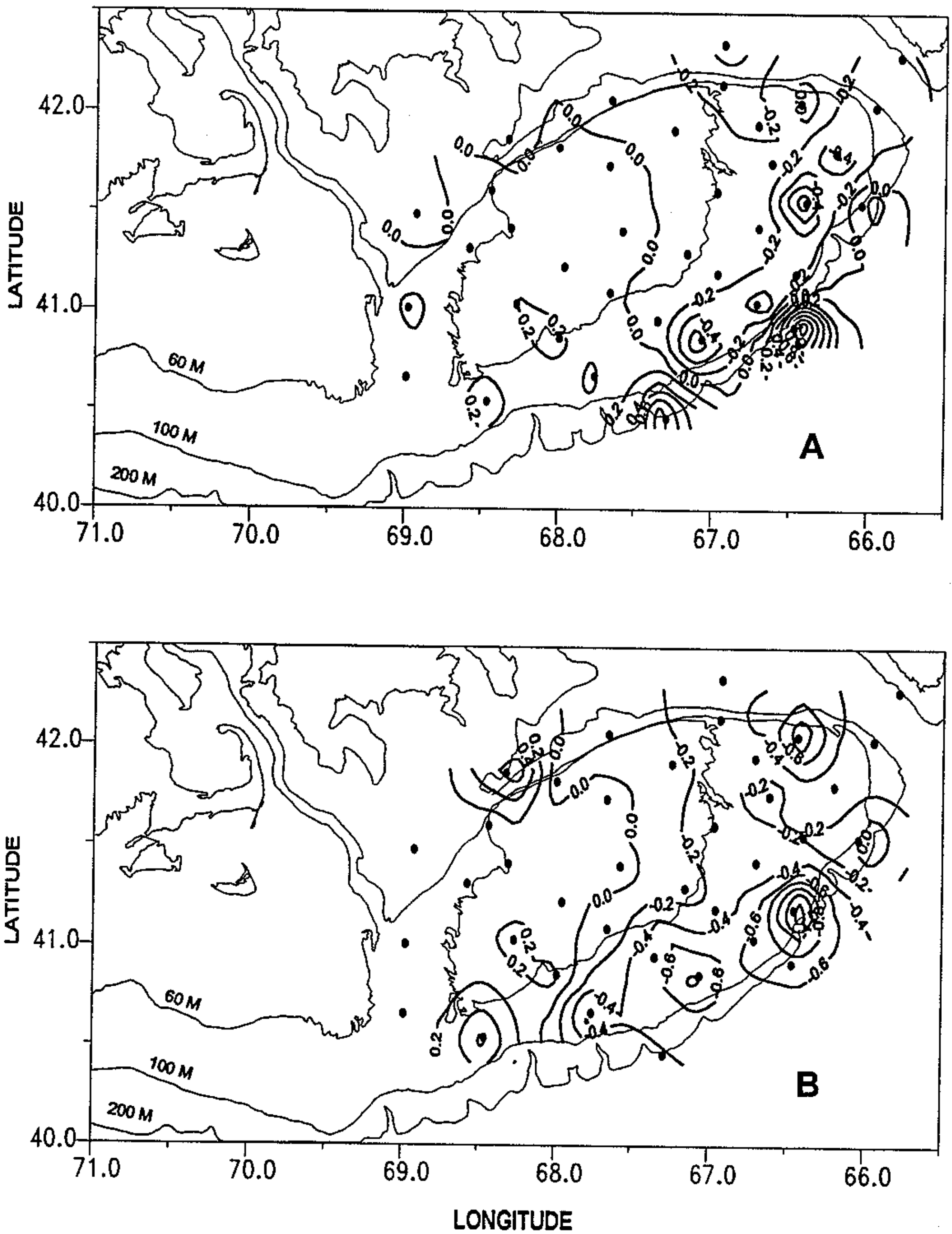
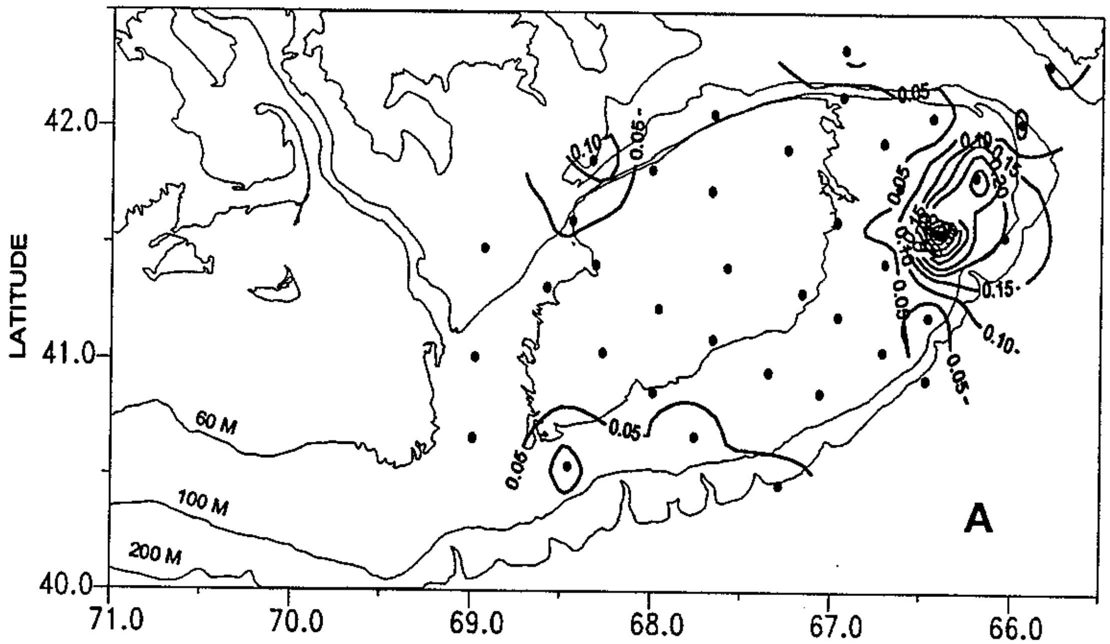


Figure 6. Surface (A) and bottom (B) salinity anomaly distributions
during broad - scale survey EN263



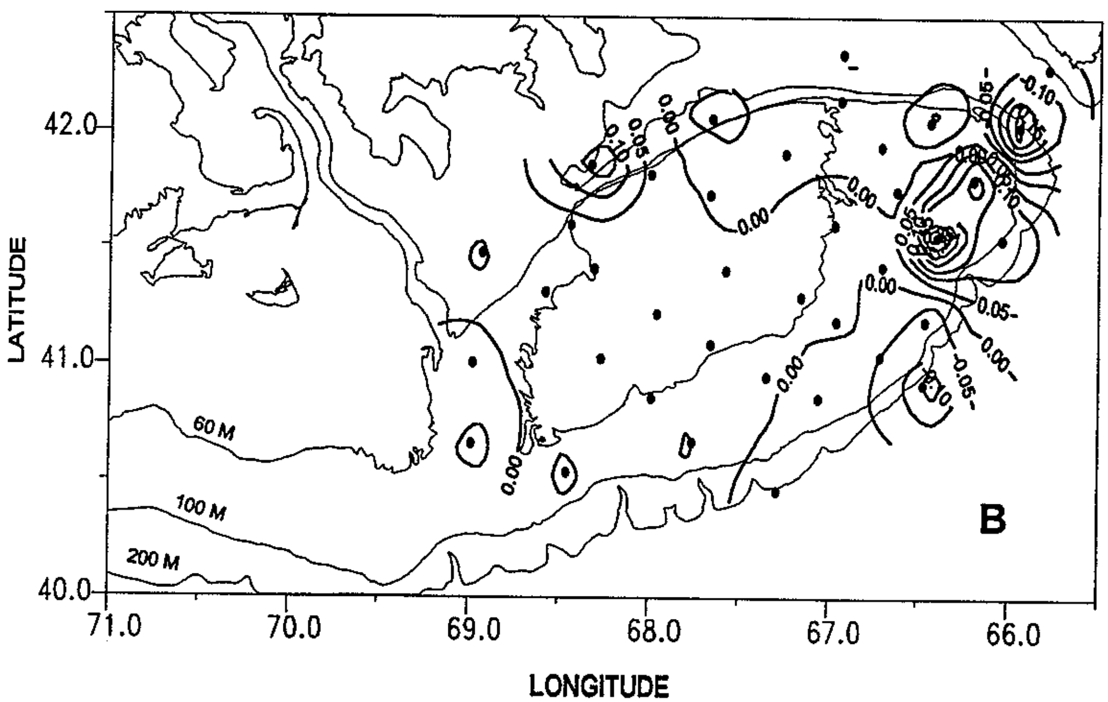


Figure 7. A) Density stratification (surface to 30 m) and B) stratification anomaly during broad - scale survey EN263.

The surface distribution figures show that the eastern portion of the Bank was slightly colder and fresher than the MARMAP reference while the northwestern part of the Bank was approximately 1°C warmer than the MARMAP reference. On station 21, Scotian shelf water was observed down to 30 meters (salinity was less than 32 psu and temperature less than 3°C). The surface salinity anomaly distribution reveals that the "tongue" of Scotian shelf water may extend along the southern flank to 67°N (see figures 4a and 6a).

Station 25 located on the northern side of the Northeast Channel showed salinities < 32 psu down to approximately 30 meters and salinities > 34 psu beginning at 92 meters, indicating the entrance of Slope Water through the Northeast Channel into the Gulf of Maine. The intrusion of slope water into the Gulf extended along the bottom to stations 29 and 34.

Station 7 and 16 showed salinity > 35.5 psu and temperature > 13°C down to 200 meters. A warm core ring was observed in satellite imagery prior to our cruise departure just south of these stations (J. Bisagni). Slope water was observed encroaching onto the southwestern part of the bank at station 3 where the salinity was 34.01 psu at 73 meters. Slope water was not observed at this station during the first broad - scale cruise EN261.

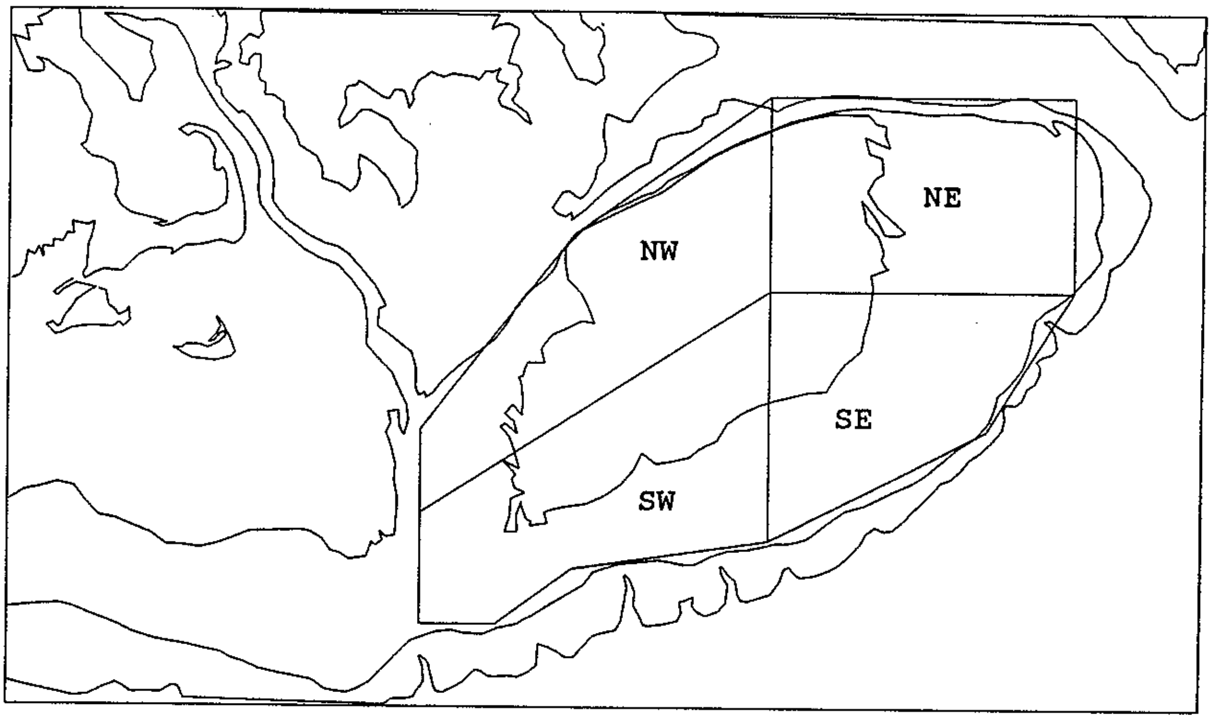
The Bank waters exhibited very little stratification during this cruise, other than at station 21 (see figure 7a). However, it is believed that the stratification at station 21 was caused by an intrusion of Scotian shelf water that has crossed the Northeast Channel and is not part of the seasonal development of thermal stratification on the southern flank of Georges Bank.

The volume average temperature and salinity of the upper 30 meters were calculated for the Bank as a whole and for four sub-regions. These values are compared with characteristic values that have been calculated from the MARMAP data set for the same areas and calendar days (figure 8). The volume of Georges Bank water (salinity < 34 psu) was also calculated and compared against the expected values. The Bank as a whole was warmer and slightly saltier than expected. The negative anomaly of Georges Bank water in the southeast sub-region may be a result of a warm core ring to the south that has brought warmer and saltier water further onto the Bank than would be expected.

Figures 9a and 9b show the surface and bottom fluorescence distribution. A comparison of the MK5 fluorescence data (in volts) with the total chlorophyll-a (mg/m^3) is shown in figure 10. The R^2 for this data is about .66.

Figure 8. Volume Average Water Properties (0-30m depth)

Temperature, Salinity and Volume of Georges Bank Water (<34 PSU)



Area	Day	Temp	Anom	Salt	Anom	Volume	Anom
Bank	75.	4.97	0.73	32.88	0.09	1027.	-1.0
NW	77.	5.42	1.25	33.16	0.14	240.	0.0
NE	76.	4.05	-0.07	32.45	-0.52	280.	0.0
SE	75.	4.66	0.23	32.60	-0.15	239.	-4.5
SW	74.	5.43	0.95	33.06	0.23	260.	1.9

[preliminary data]

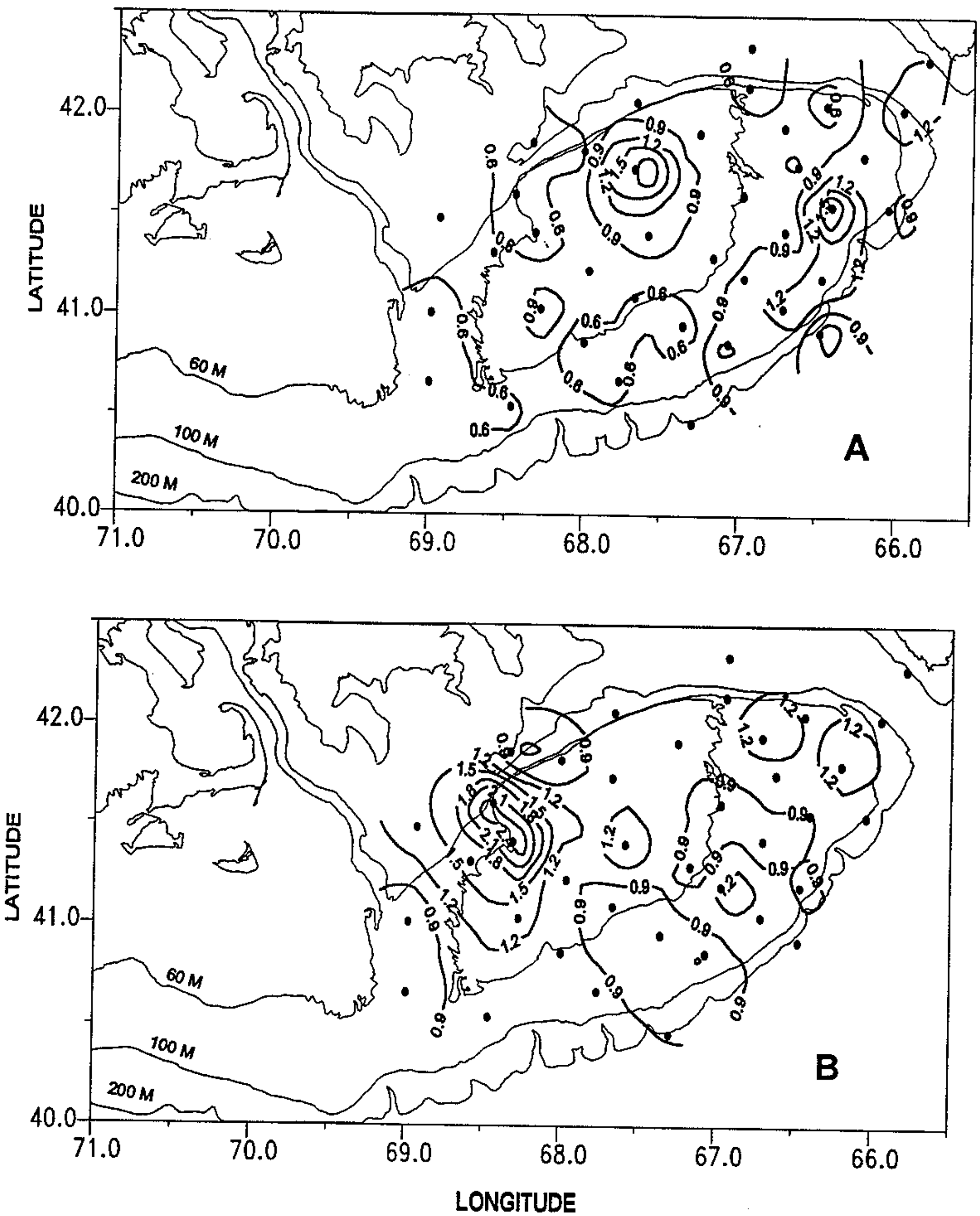


Figure 9. Surface (A) and bottom (B) fluorescence distribution (volts) during broad - scale survey EN263.

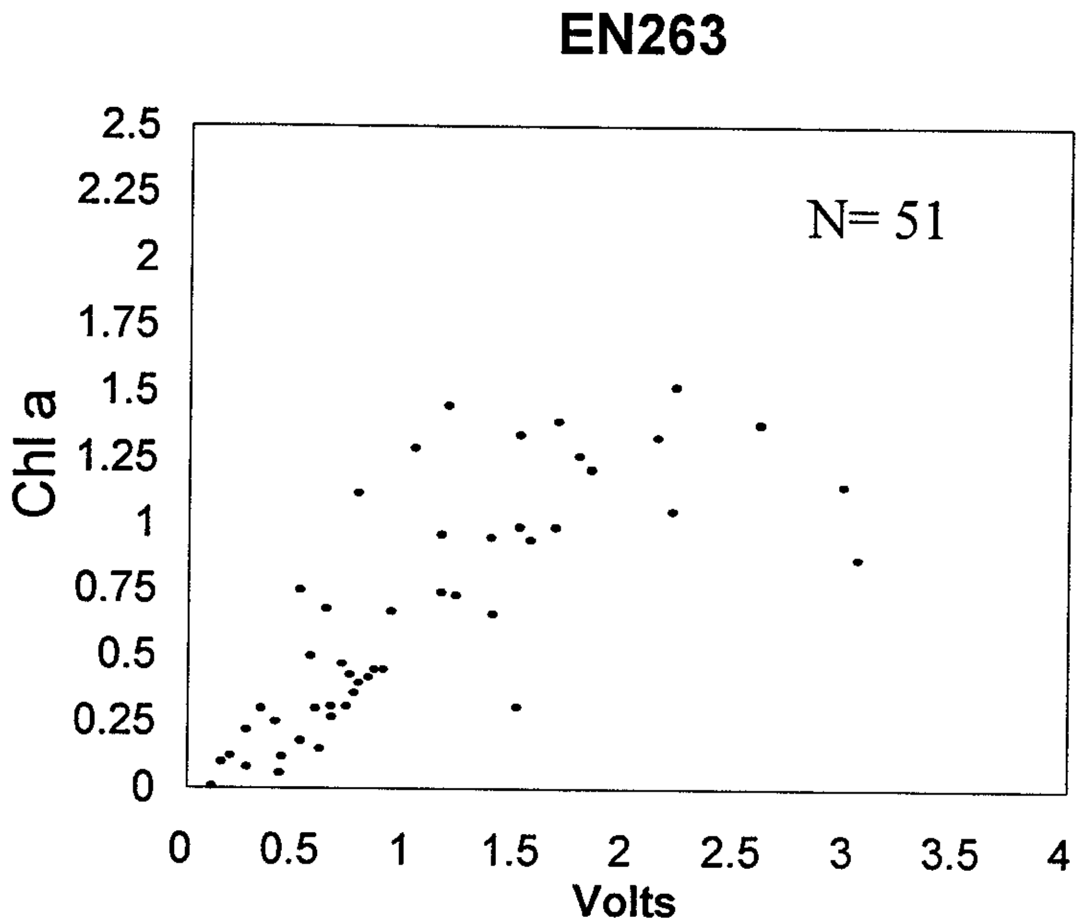


Figure 10. Comparison of the MK5 fluorometer (volts) to the total chlorophyll - a results.

Detailed Description of Sampling Methods - Maria Bemis, John Sibunka

Bongo frames were 0.61 m diameter, fitted with 335 μm nesh nets. Digital flow meters were suspended in the mouth of each net to determine volume of water filtered. Tows were made by standard MARMAP procedures: double oblique from surface to within 5 m of the bottom or a maximum depth of 200 m. Wire payout and retrieval rates were 50 and 20 m min^{-1} respectively. These rates were reduced in shallow swater (<60 m) to produce tows of at least minutes duration. The payout rate was limited to 35 m min^{-1} during adverse weather. A SeaBird CTD was attached to the towing wire above the bongo to monitor sampling depth and to recored temperature and salinity. The sample from one net was kept (4% formalin) for ichthyoplankton species composition, abundance and distribution. That from the other net was usually frozen to provide fish food for an ongoing URI experiment. At stations where the MOC-1 was not used, two bongo tows were made. One sample from the second tow was retained (10% formalin) for zooplankton species composition and abundance, the other was kept (95% ethanol) for age and growth analysis of any larval fish collected. Ethanol was changed for samples preserved in it after 24 hours.

The 1 m^2 MOCNESS (MOC-1) sampler was loaded with 10 nets. Nets 0-4 were 150 μm mesh for collection of older and larger copepodite and adult stages of zooplankton. Nets 5-8 were 335 μm mesh for zooplankton (net 5) and ichthyoplankton (nets 6-8). Tows were "double-double oblique" from the surface to within 10 meters of the bottom. The maximum tow depth for net 0 was 500 m and for net 5 200 m. Wire payout and retrieval for nets 0-5 was 15 m min^{-1}, for nets 6-10 10 m min^{-1}. Depth strata sampled were 0-15, 15-40, 40-100, >100 m. The first (#0) and sixth (#5) nets are "down" nets. For shallow stations allowing only 2 or 3 of these strata to be sampled, not all nets were fished (e.g., net 4 might be quickly opened then closed). Samples from nets 0-4 were preserved in 10% formalin, and those from nets 5-8 were preserved in 95% ethanol which was changed after 24 hours of initial preservation. Used ethanol was retained for recycling ashore.

The 10 m^2 MOCNESS (MOC-10) was equipped with 5 3.0-mm mesh nets. Tows were double oblique from surface to 15 m from the bottom. The retrieval rate was 5 m min^{-2} to allow filtering of 4,000 to 5,000 m^3 per stratum. A step oblique profile was required to obtain this volume at some stations. Intended strat were the same as for the MOC-1. Samples were preserved in 10% formalin.

A Pacer high-volume pump was used to collect nauplii and younger, smaller copepodite stages of the zooplankton. The pump intake was strapped to the wire clamp side of 1.7 liter Niskin bottle sawed vertically in half. The clamp was attached to the winch wire along with the SeaBird CTD. The reinforced suction hose was coupled to the intake. A 100 kg weight was attached to the end of the cable to pull the hose down while lowering. The hose was clipped to the cable at intervals to keep loops of it from tangling in the ship's wheel. Three, 30 m sections of hose were connected between the intake and the pump, allowing the intake nozzle to reach a maximum depth of about 70 meters. At shallow stations, the intake nozzle was lowered to within 5 m of the bottom. Three depth-integrating samples were collected with 50 μm mesh nets and preserved

Other dominant non-copepod species encountered in high abundances during this cruise were echinoderm larvae, bryozoans, barnacle nauplii, juvenile bivalves and gastropods, and larvaceans. These were especially prevalent along the northwestern and southwestern flank of Georges Bank.

Equipment Notes: The MOC-1 continued to have a problem similar to that encountered on the February Broadscale cruise. The pressure sensor on the frame has a depth offset at the surface of 3-8 meters. We're not sure if this depth offset is linear as the nets are fished through the depth stratas. It is uncertain how far from the bottom the sampler is being fished and the offset ruins accuracy in tripping of nets at predetermined depths.

The operation of the zooplankton pump on station went more smoothly than in February. As the we become more familiar with its operation, deployment and retrieval of the hose becomes easier.

Copepod Lipid and Life Stage Indicator Study - Charles Miller

Samples were taken for examination of *Calanus finmarchicus* life history processes at a subset of EN#263 stations. Preserved subsamples were collected from the MOC-1 hauls at stations 2,3,8,11,17,21,24,27,32,37,38,51,53,56, and 57. These samples will be used to examine gonad development and signs of diapause onset in fifth copepodites and for fecundity indices in females. Single fifth copepodites (usually 15 per sample) were photographed (video camera recording) and frozen in liquid nitrogen from surface and near-bottom samples at stations 2,3,8,11,17,24,32,38, and 58. These will be used for Iatroscan analysis of relative amounts of different storage lipids. As noted above, C5 were abundant at all stations and adequate numbers for recording and freezing were gathered at all stations attempted. Lipid amounts stored in the oil sac were much less in the Gulf of Maine than over Georges Bank. A difference is impled in timing of development (Gulf of Maine lagging Georges Bank) or nutrition (Georges Bank offering more food than Gulf of Maine). Large fractions of *Calanus* females at all sites were carrying eggs in the oviducts. Males were abundant at many stations, as abundant as females. This implies recent maturation of an early spring generation across much of the bank.

Ichthyoplankton Investigation - John Sibunka, Doris Finan, Alyse Weiner, Amy Tesolin, Antonie Chute, Rebecca Jones.

One of the principle objectives of the broadscale part of the U.S. Globec Georges Bank Program is to study the composition of the larval fish community on Georges Bank, to define larval fish distribution within the water column, and to determine those factors which influence their vertical distribution. Emphasis in this study is on cod and haddock larvae, along with their predators and prey. This study is to include larval distribution and abundance, analysis of feeding habits, and age and growth determination.

The samples collected at the 38 Globec Broadscale standard stations for ichthyoplankton analysis from both the bongo and MOC-1 (nets 6-9) were examined on shipboard for the presence of fish eggs and larvae. This was done in an attempt to determine their occurrence on the Bank and obtain a gross estimate of abundance and size range. Because of the high concentration of the diatom Rhizosolenia sp. in the samples collected in the south east portion of Georges Bank(Broadscale standard stations: 8,9,14,15,17,18,21-24), I found shipboard examination of these samples for fish eggs and larvae virtually impossible to make. The following discussion on ichthyoplankton catches does not include this area.

Atlantic Herring: Atlantic herring larvae (extreme size range 28-50mm, mean size range 35-40mm) dominated the catches in both abundance and occurrence during this cruise, and were caught on most of the stations occupied on the Bank. The largest catches occurred in the northwest and central portion of Georges Bank (Figure 11). Examination of MOC-1 samples collected for ichthyoplankton analysis revealed that although herring larvae occurred in the upper three depth strata sampled, most were collected in the 40-15m depth strata. In comparing larval size ranges between strata, no apparent difference in size was noticed.

Cod-Haddock: Larval cod/pollock (microscopic observation is required for separation and positive identification between the two species) were collected sporadically, with the highest incidence of capture occurring in the western portion of Georges Bank, the general area of occurrence encompassing Globec Broadscale stations 5, 10, 11. The size of larvae collected ranged from 5-25mm, with most averaging about 15mm in length. Small numbers (<5/station) of larval haddock were found in samples collected on three Broadscale standard stations (#'s: 1,12,27). Size range of these larvae were from 8-12mm (sta.#'s 1,2) and 18mm for one larva at standard station 27. The area of main occurrence of both cod/pollock (Figure 12) and haddock (Figure. 13) larvae collected this cruise agrees with historical NEFSC MARMAP data for the month of March on Georges Bank.

Sand lance: Sand lance larvae (maximum size range 10-42mm, mean size range 15-25mm) were scattered across the Bank and were the second most abundant fish larva collected during this survey. Both the highest occurrence and greatest numbers collected (up to about 50/station) were in the western portion of Georges Bank (Figure 14).

Eggs: Large catches of cod/haddock/pollock eggs (estimated 100-500/station) were seen in the bongo and MOC-1 samples collected from the Northeast Peak (Canadian waters) region of Georges Bank. Smaller catches of same (<50/station) were made in the northwest portion of the Bank. Virtually none were seen in samples collected from the stations occupied in the southern and central portion of the study area. These eggs are probably the result of cod and haddock spawning, since our historical NEFSC data indicate that by March the peak of pollock spawning has passed and catches of their eggs are generally small. The high catches of eggs from the Northeast Peak region agree well with our historical MARMAP data for March. These large gadoid eggs were also expected to occur in smaller numbers across the Bank during this survey. However,they were not seen in any appreciable numbers and in most samples not seen at all.

Participants

The scientific party on ENDEAVOR No. 263 had the following members:

1. Charles B. Miller, Oregon State University	Chief Scientist
2. John Sibunka, NOAA/NMFS, Highlands, NJ	Fishery Biologist
3. Daniel Almgren, NOAA/NMFS, Woods Hole	Hydrographer
4. Maria Bemis, GSO, URI	Plankton biologist
5. Antonie Chute, NOAA/NMFS, Narragansett, RI	Technician
6. Doris Finan, NOAA/NMFS, Highlands, NJ	Technician
7. Peter Garrahan, GSO, URI	Plankton biologist
8. Jim Gibson, GSO, URI	Technician
9. Maria Pilar Heredia, GSO, URI	Technician
10. Rebecca Jones, NOAA/NMFS, Narragansett, RI	Technician
11. Moreen Koneval, GSO, URI	Graduate student
12. John McMillan, Woods Hole, MA	Observer
13. Janis Peterson, GSO, URI	Technician
14. Maureen Taylor, NOAA/NMFS, Woods Hole	Hydrographer
15. Amy Tesolin, NOAA/NMFS, Woods Hole	Technician
16. Alyse Weiner, NOAA/NMFS, Highlands, NJ	Technician
17. David Nelsn, GSO, URI	Marine Technician

Endeavor Officers and Crew

18. Captain Thomas Tyler	Master
19. Rhett McMunn	Mate
20. Robert S. Bates	Mate
21. Jack E. Rubs	Boat-Swain
22. Paul B. Griffin	Able Seaman
23. Glen D. Prouty	Able Seaman
23. David Rocha	Able Seaman
24. William A. Appleton	Chief Engineer
25. James Cobleigh	Assistant Engineer
26. Timothy Varney	Assistant Engineer
27. Daniel Butler	Steward/Cook
28. Brian D. Miller	Cook/Messman

Appendix 1. Scientific "event" list for EN#263

Event log for U.S. GLOBEC Georges Bank Program Broadscale Survey Cruise for March 1995
R/V ENDEAVOR Cruise #263 - 13-24 March 1995
Underway, 10:00, 13 March.

event#	Instr	cast#	Sta#	BrdSt#	Mth	Day	Local hhmm	s/e	Lat	Lon	Water Depth	Cast Depth	PI	Region	Comments
001	BONGO	1	1	1	3	13	2241	S	4100.010	6859.270	81	73	Sibunka	Gt. So.	Routine
							2256	E	4100.430	6858.980	80			Channel	
002	MK5CTD	1	1	1	3	13	2311	S	4100.420	6858.820	77	73	Mountain		Routine
003	MOC-01	1	1	1	3	13	2353	S	4100.740	6857.790	83	73	Durbin		Net trip signal bad
					3	14	28	E	4101.630	6856.380	79				Net 0 blew out
004	BONGO	2	2	2	3	14	353	S	4038.920	6859.220	68	56	Sibunka		
							359	E	4039.240	6859.190	68				
005	MK5CTD	2	2	2	3	14	410	S	4039.470	6859.480	68	56	Mountain		
006	MOC-01	2	2	2	3	14	430	S	4039.780	6859.410	66	60	Durbin		
							500	E	4040.410	6858.430	66				
007	BONGO	3	3	3	3	14	824	S	4031.900	6826.900	90	83	Sibunka		
							831	E	4032.000	6826.800	90				
008	PUMP	1	3	3	3	14	855	S	4032.200	6827.000	86	80	Durbin		
009	MK5CTD	3	3	3	3	14	947	S	4032.500	6827.600	83	79	Mountain		
010	MOC-10	1	3	3	3	14	1306	S	4032.570	6825.970	85	73	Madin		Didn't catch squat
							1329	E	4032.880	6825.010	86				
011	MOC-01	3	3	3	3	14	1430	S	4031.810	6826.700	87	80	Durbin		
							1503	E	4023.280	6826.560	87				
012	BONGO	4	4	4	3	14	1819	S	4100.100	6815.100	52	47	Mountain		
							1824	E	4100.500	6815.300	52				
013	PUMP	2	4	4	3	14	1840	S	4101.000	6815.700	44	40	Durbin		
014	MK5CTD	4	4	4	3	14	1910	S	4101.700	6816.300	42	38	Mountain		
015	MOC-01	4	4	4	3	14	1920	S	4101.700	6816.700	46	36	Durbin		
							1951	E	4103.600	6815.900	43				
016	BONGO	5	5	5	3	14	2213	S	4051.100	6800.100	60	55	Sibunka		
							2219	E	4051.300	6759.900	60				
017	MK5CTD	5	5	5	3	14	2228	S	4051.300	6759.600	63	55	Mountain		
018	MOC-01	5	5	5	3	14	2245	S	4051.500	6758.420	63	53	Durbin		
							2325	E	4051.630	6757.430	64				
019	BONGO	6	6	6	3	15	120	S	4040.100	6746.000	72	67	Sibunka		

event#	Instr	cast#	Sta#	BrdSt#	Mth	Day	Local hhmm	s/e	Lat	Lon	Water Depth	Cast Depth	PI	Region	Comments
							128	E	4040.400	6745.900	73				
020	SB-WATER	1	6	6	3	15	135	S	4040.400	6746.000	72	50	Mountain		
021	MK5CTD	6	6	6	3	15	155	S	4040.400	6745.900	72	68	Mountain		
022	MOC-01	6	6	6	3	15	220	S	4040.500	6745.800	73	65	Durbin		
							255	E	4040.940	6744.900	74				
023	BONGO	7	7	7	3	15	610	S	4027.100	6717.900	300	202	Sibunka		
							628	E	4027.900	6717.800	300				
024	PUMP	3	7	7	3	15	644	S	4028.000	6717.800	300	67	Durbin		
025	MK5CTD	7	7	7	3	15	727	S	4027.900	6717.600	300	200	Mountain		
026	MOC-01	7	7	7	3	15	803	S	4028.240	6717.240	215	200	Durbin		
							909	E	4029.650	6716.760	185				
027	BONGO	8	8	8	3	15	1220	S	4052.200	6703.200	85	80	Sibunka		
							1229	E	4051.800	6703.800	85				
028	MK5CTD	8	8	8	3	15	1240	S	4051.800	6703.900	85	80	Mountain		
029	MOC-01	8	8	8	3	15	1314	S	4051.460	6704.590	87	80	Durbin	Southern flank	
							1349	E	4051.640	6706.340	87				
030	BONGO	9	9	9	3	15	1528	S	4057.900	6719.500	75	70	Sibunka		
							1534	E	4057.800	6719.900	74				
031	PUMP	4	9	9	3	15	1547	S	4057.700	6720.000	74	68	Durbin		
032	MK5CTD	9	9	9	3	15	1640	S	4056.900	6720.900	78	72	Mountain		
033	MOC-01	9	9	9	3	15	1650	S	4056.760	6721.320	80	73	Durbin		
							1728	E	4057.480	6722.230	78				
034	BONGO	10	10	10	3	15	1934	S	4105.200	6739.100	57	54	Sibunka		
							1935	E	4105.500	6739.400	57				
035	MK5CTD	10	10	10	3	15	1947	S	4105.600	6739.600	54	50	Mountain		
036	MOC-01	10	10	10	3	15	2000	S	4106.300	6739.700	54	44	Durbin		
							2027	E	4107.100	6739.600	54	44			
037	BONGO	11	11	11	3	15	2308	S	4113.900	6757.700	49	46	Sibunka	Crest	
							2314	E	4113.900	6757.900	49				
038	SB-WATER	2	11	11	3	15	2325	S	4113.700	6757.800	48	44			
039	MK5CTD	11	11	11	3	15	2344	S	4113.300	6757.600	49	45	Mountain		
040	MOC-01	11	11	11	3	16	5	S	4112.700	6757.090	47	40	Durbin		
							25	E	4112.620	6756.860	45				
041	DRIFTER	1 A			3	16	141	S	4114.960	6800.040	45	0	Limeburner		
042	BONGO	12	12	12	3	16	415	S	4124.200	6733.400	31	26	Sibunka		
							422	E	4124.200	6734.100	33				
043	MK5CTD	12	12	12	3	16	430	S	4124.100	6734.700	33	28	Mountain		

event#	Instr	cast#	Sta#	BrdSt#	Mth	Day	Local hhmm	s/e	Lat	Lon	Water Depth	Cast Depth	PI	Region	Comments
044	PUMP	5	12	12	3	16	455	S	4124.000	6735.400	30	25	Durbin		
045	MOC-01	12	12	12	3	16	536	S	4124.330	6736.580	35	30	Durbin		
							548	E	4125.160	6737.320	35				
046	DRIFTER	2	B		3	16	649	S	4128.060	6731.260	32	0	Limeburner		
047	BONGO	13	13	13	3	16	909	S	4116.600	6710.200	52	50	Sibunka		
							914	E	4116.800	6710.200	53				
048	PUMP	6	13	13	3	16	950	S	4117.100	6710.100	53	45	Durbin		
049	MK5CTD	13	13	13	3	16	1019	S	4117.200	6709.900	54	47	Mountain		
050	MOC-01	13	13	13	3	16	1030	S	4117.300	6709.600	58	48	Durbin		
							1101	E	4117.900	6708.900	59				
051	BONGO	14	14	14	3	16	1255	S	4111.800	6657.100	65	61	Sibunka		
							1302	E	4111.500	6657.700	65				
052	MK5CTD	14	14	14	3	16	1313	S	4111.500	6657.800	65	60	Mountain		
053	MOC-01	14	14	14	3	16	1335	S	4111.190	6657.710	65	60	Durbin		
							1357	E	4111.420	6657.570	67				
054	BONGO	15	15	15	3	16	1606	S	4101.900	6642.000	75	72	Sibunka		
							1611	E	4102.100	6642.200	75				
055	MK5CTD	15	15	15	3	16	1620	S	4102.100	6642.200	75	70	Mountain		
056	MOC-01	15	15	15	3	16	1633	S	4102.000	6642.420	80	70	Durbin		
							1718	E	4103.300	6642.410	80				
057	BONGO	16	16	16	3	16	1909	S	4055.260	6627.100	800	199	Sibunka		
							1929	E	4055.800	6627.300	750				
058	PUMP	7	16	16	3	16	1944	S	4055.600	6627.700	650	70	Durbin		
059	MK5CTD	16	16	16	3	16	2020	S	4055.100	6628.300	540	250	Mountain		
060	MOC-01	16	16	16	3	16	2055	S	4054.500	6628.200	455	440	Durbin		2nd Downcast - 200 m
							2304	E	4057.400	6627.100	393				
061	BONGO	17	17	17	3	17	103	S	4111.900	6627.000	91	86			
							114	E	4111.700	6627.500	91				
062	MK5CTD	17	17	17	3	17	123	S	4111.500	6627.600	91	86	Mountain		
063	PUMP	8	17	17	3	17	147	S	4111.000	6627.500	89	80	Durbin		
064	MOC-01	17	17	17	3	17	300	S	4110.330	6627.200	90	85	Durbin		
							346	E	4110.760	6627.290	90				
065	BONGO	18	18	18	3	17	610	S	4124.600	6641.900	80	75	Sibunka		
							621	E	4125.000	6642.200	80				
066	MK5CTD	18	18	18	3	17	630	S	4125.100	6642.200	79	74	Mountain		
067	PUMP	9	18	18	3	17	723	S	4125.300	6643.000	79	72	Durbin		Boat hook MIA
068	MOC-01	18	18	18	3	17	750	S	4126.300	6644.600	80	70	Durbin		

event#	Instr	cast#	Sta#	BrdSt#	Mth	Day	Local hhmm	s/e	Lat	Lon	Water Depth	Cast Depth	Pl	Region	Comments
							840	E	4126.600	6643.000	82				
069	MOC-10	2	18	18	3	17	925	S	4125.500	6641.400	85	78	Madin		Connection to U/W unit lost for brief time
							1030	E	4125.400	6639.800	86				
070	BONGO	19	19	19	3	17	1328	S	4136.000	6658.800	59	54	Sibunka		
							1334	E	4135.900	6658.300	58				
071	SB-WATER	3	19	19	3	17	1340	S	4135.900	6658.100	58	50	Mountain		
072	MK5CTD	19	19	19	3	17	1352	S	4135.800	6658.100	59	55	Mountain		
073	MOC-01	19	19	19	3	17	1417	S	4134.960	6657.500	62	55	Durbin		
							1437	E	4134.200	6657.030	60				
074	DRIFTER	3 C			3	17	1547	S	4140.969	6603.008		0	Limeburner		
075	BONGO	20	20	20	3	17	1830	S	4142.900	6633.800	76	65	Sibunka		
							1839	E	4142.800	6633.700	76	65			
076	PUMP	10	20	20	3	17	1925	S	4143.400	6635.100	72	60	Durbin		
077	MK5CTD	20	20	20	3	17	2031	S	4145.200	6637.000	70	63	Mountain		
078	MOC-01	20	20	20	3	17	2050	S	4145.900	6636.400	71	61	Durbin		
							2128	E	4146.200	6635.600	74				
079	BONGO	21	21	21	3	17	2347	S	4132.300	6623.900	87	84	Sibunka		
							2355	E	4132.800	6623.700	87				
080	MK5CTD	21	21	21	3	18	10	S	4132.900	6623.700	85	80	Mountain		
090	MOC-01	21	21	21	3	18	30	S	4133.250	6623.260	88	80	Durbin		
							120	E	4134.270	6622.140	85				
091	BONGO	22	22	22	3	18	312	S	4133.100	6601.700	110	103	Sibunka		
							324	E	4132.400	6602.500	110				
092	MK5CTD	22	22	22	3	18	330	S	4132.300	6602.600	108	102	Mountain		
093	MOC-01	22	22	22	3	18	400	S	4131.500	6603.000	110		Durbin		Aborted-No Sample
094	BONGO	23	23	23	3	18	635	S	4147.900	6611.500	80	75	Sibunka		
							642	E	4148.000	6612.300	80				
095	MK5CTD	23	23	23	3	18	650	S	4148.100	6612.800	80	74	Mountain		
096	PUMP	11	23	23	3	18	735	S	4148.500	6615.100	80	56	Durbin		
097	BONGO	24	23	23	3	18	912	S	4148.500	6612.300	82	81	Sibunka		
							919	E	4149.200	6612.900	82				
098	MOC-01	23	23	23	3	18	1106	S	4150.200	6612.300	80		Durbin		Abort-Termination Bad
099	BONGO	25	24	24	3	18	1310	S	4202.900	6557.000	167	160	Sibunka		
							1322	E	4202.200	6557.100	166				
100	MK5CTD	24	24	24	3	18	1345	S	4202.000	6557.000	160	152	Mountain		
101	MOC-01	24	24	24	3	18	1413	S	4201.200	6556.370	163	155	Durbin		
							1505	E	4200.650	6554.520	175				

event#	Instr	cast#	Sta#	BrdSt#	Mth	Day	Local hhmm	s/e	Lat	Lon	Water Depth	Cast Depth	PI	Region	Comments
102	BONGO	26	25	25	3	18	1751	S	4213.700	6541.300	210	199	Sibunka		
							1810	E	4213.800	6542.800	208				
103	PUMP	12	25	25	3	18	1830	S	4213.700	6543.700	225	60	Durbin		
104	BONGO	27	25	25	3	18	1953	S	4214.300	6543.600	210	200	Sibunka		No MOC-1 due to weather
							2035	E	4216.400	6546.500	210				
105	MK5CTD	25	25	25	3	18	2055	S	4216.900	6547.100	200	170	Mountain		
106	BONGO	28	26	26	3	19	50	S	4203.900	6626.100	80	75	Sibunka		
							100	E	4203.600	6626.400	80				
107	MK5CTD	26	26	26	3	19	110	S	4203.300	6626.200	80	75	Mountain		
108	MOC-01	25	26	26	3	19	135	S	4203.210	6625.630	88	80	Durbin		
							205	E	4203.330	6624.650	83				
109	BONGO	29	27	27	3	19	415	S	4156.600	6641.800	62	55	Sibunka		
							421	E	4156.200	6642.300	65				
110	MK5CTD	27	27	27	3	19	430	S	4156.100	6642.400	65	58	Mountain		
111	PUMP	13	27	27	3	19	510	S	4155.300	6643.600	68	36	Durbin		Hard to get hose down
112	MOC-01	26	27	27	3	19	551	S	4155.200	6644.900	69	60	Durbin		
							616	E	4155.700	6645.400	69				
113	BONGO	30	28	28	3	19	826	S	4205.600	6653.800	63		Sibunka		
							832	E	4206.400	6654.700	64				
114	BONGO	31	28	28	3	19	850	S	4207.100	6655.300	64	61	Sibunka		
							856	E	4207.600	6655.700	63				
115	MK5CTD	28	28	28	3	19	910	S	4208.300	6656.300	65	60	Mountain		
116	BONGO	32	29	29	3	19	1102	S	4217.900	6654.100	295	202	Sibunka		
							1126	E	4219.100	6654.900	295				
117	PUMP	14	29	29	3	19	1149	S	4219.400	6655.300	290	53	Durbin		
118	MK5CTD	29	29	29	3	19	1230	S	4220.100	6655.900	290	250	Mountain		
119	BONGO	33	29	29	3	19	1255	S	4220.600	6656.200	290	200	Sibunka		
							1315	E	4221.100	6656.300	290				Stormy - Bongo to replace MOC-1
120	BONGO	34	30	30	3	19	1641	S	4154.900	6714.100	50	49	Sibunka		
							1647	E	4154.900	6714.500	50				
121	PUMP	15	30	30	3	19	1708	S	4154.800	6714.900	50	48	Durbin		
122	MK5CTD	30	30	30	3	19	1825	S	4154.800	6714.700	50	47	Mountain		
123	MOC-01	27	30	30	3	19	1835	S	4155.400	6715.600	68	57	Durbin		Repair small tear in net #1.
							1916	E	4156.500	6715.900	59				
124	BONGO	35	31	31	3	19	2135	S	4203.000	6739.200	130	124	Sibunka		
							2146	E	4203.500	6739.800	130				
125	SB-WATER	4	31	31	3	19	2156	S	4203.500	6739.800	140	50	Mountain		

event#	Instr	cast#	Sta#	BrdSt#	Mth	Day	Local hhmm	s/e	Lat	Lon	Water Depth	Cast Depth	PI	Region	Comments
126	MK5CTD	31	31	31	3	19	2213	S	4203.600	6739.900	160	150	Mountain		
127	MOC-01	28	31	31	3	19	2230	S	4203.700	6739.600	170	158	Durbin		
							2335	E	4205.200	6738.400	176				
128	BONGO	36	32	32	3	20	225	S	4143.900	6740.800	40	37	Sibunka		
							232	E	4143.900	6740.600	40				
129	MK5CTD	32	32	32	3	20	236	S	4143.900	6740.300	54	50	Mountain		
130	MOC-01	29	32	32	3	20	257	S	4143.690	6739.790	50	40	Durbin		
							320	E	4144.020	6739.280	40				
131	DRIFTER	4 E			3	20	453	S	4149.920	6744.940	33	0	Limeburner		
132	BONGO	37	33	33	3	20	605	S	4149.800	6759.600	53	46	Sibunka		
							611	E	4149.300	6759.900	53				
133	SB-WATER	5	33	33	3	20	618	S	4149.200	6759.900	52	41	Mountain		
134	MK5CTD	33	33	33	3	20	635	S	4149.200	6800.000	51	45	Mountain		
135	MOC-01	30	33	33	3	20	708	S	4148.490	6801.270	50	40	Durbin		
							725	E	4148.310	6801.910	50				
136	BONGO	38	34	34	3	20	900	S	4151.000	6818.100	216	202	Sibunka		
							921	E	4151.100	6819.100	220				
137	PUMP	16	34	34	3	20	938	S	4151.100	6819.400	220	60	Durbin		
138	MK5CTD	34	34	34	3	20	1022	S	4151.600	6819.800	210	207	Mountain		
139	MOC-10	3	34	34	3	20	1130	S	4151.530	6818.860	220	205	Madin		
							1242	E	4149.430	6818.940	196				
140	MOC-01	31	34	34	3	20	1347	S	4149.260	6818.860	198	191	Durbin		
							1504	E	4148.920	6818.710	190				
141	BONGO	39	35	35	3	20	1647	S	4135.900	6826.900	74	56	Sibunka		
							1652	E	4135.800	6826.600	72				
142	MK5CTD	35	35	35	3	20	1701	S	4135.700	6826.500	64	60	Mountain		
143	MOC-01	32	35	35	3	20	1730	S	4135.500	6827.000	70	60	Durbin		
							1813	E	4134.800	6826.800	67				
144	BONGO	40	36	36	3	20	2001	S	4123.900	6818.000	50	46	Sibunka		
							2007	E	4123.800	6817.900	50				
145	MK5CTD	36	36	36	3	20	2104	S	4124.700	6818.600	50	45	Mountain		
146	MOC-01	33	36	36	3	20	2125	S	4125.160	6818.030	50	40	Durbin		Net #9 had rips in stress area
							2148	E	4125.030	6819.000	50				
147	DRIFTER	5 D			3	20	2334	S	4124.000	6830.020	82	0	Limeburner		
148	BONGO	41	37	37	3	21	35	S	4118.000	6835.900	65	59	Sibunka		
149	MK5CTD	37	37	37	3	21	50	S	4118.500	6835.000	65	59	Mountain		
150	MOC-01	34	37	37	3	21	110	S	4118.770	6834.820	67	62	Durbin		

event#	Instr	cast#	Sta#	BrdSt#	Mth	Day	Local hhmm	s/e	Lat	Lon	Water Depth	Cast Depth	PI	Region	Comments
							141	E	4118.380	6835.480	67				
151	BONGO	42	38	38	3	21	400	S	4129.200	6856.900	152	142	Sibunka		
							412	E	4129.300	6855.900	148				
152	MK5CTD	38	38	38	3	21	425	S	4128.700	6855.900	148	139	Mountain		
153	PUMP	18	38	38	3	21	450	S	4128.500	6855.600	142	70	Durbin		
154	MOC-01	35	38	38	3	21	622	S	4126.910	6855.520	143	130	Durbin		
							715	E	4124.960	6856.050	144				
155	BONGO	43	39		3	21	1255	S	4105.100	6753.000	47	39	Sibunka	Start of "Gadid Grid"	
							1301	E	4105.200	6752.300	47				
156	MOC-01	36	39		3	21	1334	S	4105.100	6752.050	46	40	Durbin		
							1354	E	4104.400	6751.210	47				
157	BONGO	44	40		3	21	1305	S	4059.900	6752.900	48	38	Sibunka		
							1311	E	4059.800	6751.700	48				
158	BONGO	45	41		3	21	1607	S	4055.700	6748.000	55	50	Sibunka		
							1611	E	4055.300	6747.300	55				
159	MOC-01	37	41		3	21	1631	S	4054.710	6746.650	60	50	Durbin		
							1654	E	4053.820	6745.870	64				
160	BONGO	46	42		3	21	1835	S	4059.600	6745.900	51	48	Sibunka		
							1840	E	4059.300	6745.700	51				
161	BONGO	47	43		3	21	1947	S	4054.900	6739.000	66	62	Sibunka		Aborted- heavy rollers
							1957	E	4054.500	6738.800	66				
162	BONGO	48	43		3	21	2140	S	4054.400	6739.700	58	52	Sibunka		
							2147	E	4054.200	6739.900	58				
163	BONGO	49	44		3	21	2250	S	4055.000	6732.400	75	71	Sibunka		
							2259	E	4054.900	6732.700	75				
164	BONGO	50	45		3	22	5	S	4100.300	6739.100	60	55	Sibunka		
							15	E	4100.200	6739.400					
165	BONGO	51	45		3	22	15	S	4100.100	6739.600	60	55	Sibunka		
							33	E	4059.900	6739.700					
166	BONGO	52	46		3	22	140	S	4105.300	6747.000	48	45	Sibunka		
							151	E	4105.100	6747.100	48				
167	BONGO	53	47		3	22	245	S	4104.900	6738.900	51	45	Sibunka		
							251	E	4104.500	6738.700	51				
168	MOC-01	38	47		3	22	323	S	4103.440	6737.570	56	50	Durbin		
							353	E	4102.510	6736.640	58				
169	BONGO	54	48		3	22	515	S	4104.800	6732.300	56	51	Sibunka		
							522	E	4104.400	6732.200	56				

event#	Instr	cast#	Sta#	BrdSt#	Mth	Day	Local hhmm	s/e	Lat	Lon	Water Depth	Cast Depth	PI	Region	Comments
170	BONGO	55	49		3	22	645	S	4109.800	6738.900	48	43	Sibunka		
							651	E	4109.300	6739.000	48				
171	MOC-1	39	49		3	22	700	S	4108.790	6739.350	50	40	Durbin		
							725	E	4107.700	6740.230	50				
172	BONGO	56	50		3	22	839	S	4109.900	6745.600	40	35	Sibunka		End of gadid grid
							844	E	4109.700	6746.500	40				
173	MK5CTD	39	51		3	22	12.25	S	4148.900	6751.000	36	32	Mountain	Start of copepod transect	
174	MOC-01	40	51		3	22	1241	S	4149.060	6751.070	38	35	Durbin		
							1248	E	4149.020	6750.960	40				
175	MK5CTD	40	52		3	22	1347	S	4153.100	6752.800	51	44	Mountain		
176	MK5CTD	41	53		3	22	1433	S	4157.200	6753.700	98	92	Mountain		
177	MOC-01	41	53		3	22	1450	S	4156.750	6753.120	94	75	Durbin		
							1509	E	4156.140	6752.390	85				
178	MK5CTD	42	54		3	22	1623	S	4201.500	6755.800	195	189	Mountain		
179	MK5CTD	43	55		3	22	1714	S	4206.000	6756.800	222	200	Mountain		
180	MK5CTD	44	56		3	22	1826	S	4209.500	6757.200	230	200	Mountain		
181	MOC-1	42	56		3	22	1850	S	4209.270	6756.470	230	220	Durbin		
							2000	E	4209.270	6752.350	221				
182	Mk5-CTD	45	57		3	22	2303	S	4219.000	6821.900	200	190	Mountain		
183	MOC-1	43	57		3	22	2324	S	4218.950	6821.830	210	200	Durbin		
					3	23	6	E	4219.600	6823.830	210				
184	MOC-1	44	58		3	23	600	S	4141.700	6913.900	190	170	Durbin		333 only to check *Calanus* quantities prior to live collections
							650	E	4140.490	6912.340	185				