BIOMAC

A Proposal for a
Joint U.S.-Polish-Canadian
Spawning Biomass Assessment

of

Atlantic Mackerel, Scomber scombrus off
Northeastern United States and Canada
April through August 1987

Draft Prepared by

W. G. Smith

National Marine Fisheries Service
Northeast Fisheries Center
Ichthyoplankton Assessment Investigation
Sandy Hook Laboratory
Highlands, New Jersey 07732

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SHL No. 87-01

BACKGROUND: The United States and Poland have been conducting joint studies on the abundance, distribution, and availability to the fisheries of the dominant fish species of the Northeast Shelf (NES) ecosystem since 1973. As part of these studies the U.S. side has discovered a very large biomass of sand lance (Ammodytes spp.) estimated at one million metric tons. Investigation of predator-prey relationships among sand lance, herring, and mackerel suggest that major changes in the abundance of these species are the result of changes in predation mortality. The changes are in turn related to fishing. As heavy fishing mortality reduces the size of adults and juveniles of any one of the three species, the other species will benefit from the reduction in natural predation mortality.

Because of the drastic reduction in herring on Georges Bank from the mid-1970's to the present, fishing predation has declined and some evidence for the initiation of a recovery trend has been observed for the mackerel stocks followiong the sharply curtailed fishery on mackerel in the late 1970's and early 1980's. It is not clear, however, just what the total biomass of mackerel is at present within the NES ecosystem. To obtain a reliable estimate, NEFC proposes that cooperative ichthyoplankton survey be conducted in the western North Atlantic during the spring 1987 spawning season with U.S., Polish and Canadian ships and scientific personnel. Abundance and predation of eggs during the course of the spawning season will be used to estimate the size of the population(s). Six surveys during the 3-month period from mid April through mid July will cover mackerel spawning grounds from Cape Hatteras to the Gulf of St. Lawrence.

It is essential to obtain a quantitative estimate of adult spawning biomass if we are to improve forecasts of abundance trends over the next five years for Atlantic herring and sand lance. We will use the information to test the validity of the predator-prey models for the pelagic fish component of the NES ecosystem which were developed by the staff of the Northeast Fisheries Center.

OBJECTIVES: (1) Estimate the absolute abundance of Atlantic mackerel in the western North Atlantic from Cape Hatteras to the Gulf of St. Lawrence using ichthyoplankton survey information; (2) Collect information on adult mackerel population from trawling operations in keeping with past efforts of CUD to assess status of stocks and impact of fishing activities; (3) Evaluate the importance of Atlantic mackerel as predators; (4) Examine the relationship between water quality and chromosomal abnormalities in mackerel eggs; (5) Determine contaminant body burden levels; and (6) Estimate fecundity of adult females prior to spawning.

FIELD ITINERARY: This cooperative endeavor will be a 2-phase operation. Biological observations and collections related to adult mackerel i.e., length/frequency, weight/frequency, age, maturity stage, fecundity, body burdens etc., will be made during trawling operations on Admiral Arciszewski and F/V Kublin from January through May 1987 (Table 1).. Objectives, itinerary and operational plan for fishing activities are outlined in Attachment #1. General Instructions to scientists/technicians regarding the collection of data for the Conservation and Utilization Division during trawling operations are summarized in Attachment #2.

Surveys of Atlantic mackerel eggs will be conducted from Admiral Arciszewski, R/V Delaware II, R/V Wieczno and R/V Prince from April through July (Table 2). Objectives, itinerary, operational plan and sampling activities for these cruises, along with general guidelines for processing ovaries in the laboratory, are outlined in the following pages.

TABLE 1. U.S.-Polish cooperative Atlantic mackerel research scheduled for Admiral Arciszewski (AR-87-01) and F/V Kulbin (KU-87-01).

Research Vessel	87-01 Part	Cruise Dates	Sea Days	Area of Operation
Admiral Arciszewski F/V Kulbin	I	1/16-2/10	27	Cape Hatteras to Georges Bank
Admiral Arciszewski F/V Kulbin	II	2/12-3/10	27	Cape Hatteras to Georges Bank
Admiral Arciszewski F/V Kulbin	III	3/12-4/7	27	Cape Hatteras to Georges Bank
Admiral Arciszewski F/V Kulbin	IV	4/9-5/5	27	Cape Hatteras to Georges Bank
Admiral Arciszewski F/V Kulbin	V	5/7-5/22	16	Cape Hatteras to Georges Bank

TABLE 2. U.S.-Polish Ichthyoplankton schedule to survey Atlantic mackerel eggs and larvae.

Research Vessel	Cruise Dates	Sea Days	Area Covered	Total Stations
Arciszewski	4/13-4/24	12	Oregon Inlet, N.C. to Montauk Pt., N.Y.	94
Delaware II	5/4-5/18	15	Chesapeake Bay, VA, to Martha's Vineyard, MA	90
Wieczno	5/27-6/13	17	Chincoteague, VA, to Cape Ann, MA.	132
Wieczno	6/15-7/1	17	Cape Henlopen, DE., to Bay of Fundy	125
Wieczno	7/3-7/15	10	Sandy Hook, N.J. to Bay of Fundy	100
Prince	6/15-7/3	18	Gulf of St. Lawrence	85
			TOTAL	626

BIOMAC ACTIVITIES ON ADMIRAL ARCISZEWSKI

In addition to duties outlined in Attachment #2, scientists/technicians on Arciszewski will make observations/collection related to BIOMAC fecundity studies. The primary purpose of fecundity studies is to derive the relationships between the number of eggs spawned and fish length, weight and/or age. For biomass estimates fish weight is the most useful. If the population contains different stocks, groups or units which may have different fecundities then each stock should be sampled adequately for statistical comparisons of the relationships. Collecting and analytical methods for estimating fecundity must remain consistent throughout the study.

Sample size must be adequate during the appropriate time within the spawing season. The number of samples depends upon the length, weight and age ranges of the species under investigation. For Atlantic mackerel there is a relatively short length and weight range to consider but a rather large age range (2-15 years). Samples should be stratified to provide fairly even representation across the range of each biological parameter within each stock.

Ovary samples used for fecundity estimates must be at same stage of development. Our objective is to include ovaries at a stage advanced enough to produce accurate egg counts prior to the onset of spawning. Once the ovaries have been staged and selected, counts will be made on eggs greater than or equal to 0.10 mm in diameter. For many species this egg size is reached when yolk deposition is clearly evident. For BIOMAC we will use maturity stages described in Table 3.

TABLE 3. Maturity stages of Atlantic mackerel ovaries for BIOMAC.

Stage	Description
1. Resting	Ovary small, ribbonlike. No eggs visible.
2. Developing	Ovary enlarged, usually orange colored with a granular appearance. No translucent eggs, maximum egg diameters 0.8-0.9 mm.
3. Ripe	Ovary fills most of gut cavity, yellow colored, in advanced stage some translucent eggs are visible through wall. Maximum egg diameter 1.0-1.2 mm.
4. Running ripe	Similar in appearance to stage 2, eggs are extruded with pressure on abdomen of fish. Maximum egg diameters 1.2-1.4 mm.
5. Partially spent	Ovary is flaccid, often hemorrhaging is evident at anterior portion of ovary, some residual mature eggs (1.1-1.4 mm) present.

Atlantic mackerel spawning is concentrated in the late March through May time period off northeastern United States. To estimate the fecundity, we will make the following collections/observations on each part of Arciszewski Cruise 87-01.

Part 1 (16 Jan - 10 Feb)
Freeze 30 fish for onshore fecundity studies at beginning, midpoint and end of cruise (total 90). The length composition of the samples should be representative of the catch. Place the fish in plastic bags prior to freezing. A label inside the bag and one securely attached to the outside of the bag should include: name of ship, date of capture, location of capture. These fish should be taken from an area of the net other than the cod end to assure that fish are in good condition and eggs are not extruded from ovaries.

Part 2 (12 Feb. - 10 Mar)
Freeze 50 fish during each of first 2 weeks of Part 2 and 100 fish during each of second 2 weeks (total 300) for onshore fecundity studies. The length composition of the samples should be representative of the catch. Place the fish in plastic bags for freezing. A label inside the bag and one securely attached to the outside of the bag should include: name of ship, date of capture, location of capture. These fish should be taken from an area of the net other than the cod end to assure that fish are in good condition and eggs are not extruded from ovaries. Examine gonads from 100 fish each week by carefully cutting into the body cavity to determine sex and stage of maturity. Record fish length, sex and stage of maturity as noted in Table 3 on trawl log.

Part 3 (12 Mar. - 7 Apr)
Freeze 200 fish weekly (total 800) for onshore fecundity studies. Spawning will be underway during this part of the cruise. Proper sampling and careful handling of fish is critically important. The length composition of the samples should be representative of the catch. Place the fish in plastic bags for freezing. A label inside the bag and one securely attached to the outside of the bag should include: name of ship, date of capture, location of capture. These fish should be taken from an area of the net other than the cod end to assure that fish are in good condition and eggs are not extruded from ovaries. Examine gonads from 100 fish each week by carefully cutting into the body cavity to determine sex and stage of maturity. Record fish length, sex and stage of maturity as noted in Table 3 on trawl log.

Part 4 (9 Apr.-5 May)
Most of Part 4 will be dedicated to ichthyoplankton and juvenile fish surveys of the Middle Atlantic Bight and Georges Bank, respectively. While in the Middle Atlantic Bight, trawling operations should continue to provide adult fish for research purposes. This part of the cruise occurs during the peak spawning period and proper handling and sampling of fish is very critical. Freeze a total of 800 fish for onshore fecundity studies. These fish should come from different areas within the Middle Atlantic Bight. Their length composition of the samples should be representative of the catch. Place the fish in plastic bags for freezing. A label inside the bag and one securely attached to the outside of the bag should include: name of ship, date of capture, location of capture. These fish

should be taken from an area of the net other than the cod end to assure that fish are in good condition and eggs are not extruded from ovaries. Examine gonads from 100 fish each week by carefully cutting into the body cavity to determine sex and stage of maturity. Record fish length, sex and stage of maturity as noted in Table 3 on trawl log.

Part 5 (7 May-22 May)
Spawning will continue during this part of the cruise. Proper sampling and careful handling of fish is critically important. Freeze 150 fish during each week of the cruise (total 300) for onshore fecundity studies. The length composition of the samples should be representative of the catch. Place the fish in plastic bags for freezing. A label inside the bag and one securely attached to the outside of the bag should include: name of ship, date of capture, location of capture. These fish should be taken from an area of the net other than cod end to assure that fish are in good condition and eggs are not extruded from ovaries. Examine gonads from 100 fish each week by carefully cutting into the body cavity to determine sex and stage of maturity. Record fish length, sex and stage of maturity as noted in Table 3 on trawl log.

BIOMAC SAMPLING ACTIVITIES TO ESTIMATE ADULT SPAWNING BIOMASS

Arciszewski will conduct the first survey of Atlantic mackerel eggs. The ship will depart New York City on April 7. Survey operations will begin off Oregon Inlet on April 13. Wieczno and Delaware II will embark from Woods Hole. Sampling will proceed from south to north on all surveys which will be geographically staggered to follow the northward progression of the mackerel schools (Figure 1). The R/V Prince will depart Halifax on or about June 15 to sample the Gulf of St. Lawrence (Figure 2). Areal coverage in U.S. waters is based on the distribution of Atlantic mackerel eggs and larvae from NEFC's 10-year ichthyoplankton time series. Spawning is traditionally light to non-existent on the eastern part of Georges Bank. Cruises will extend beyond boundaries depicted in Figure 1 if mackerel eggs are observed at easternmost sampling sites.

Measurements of temperature will be completed at each station, followed by the plankton tow. Plankton will be collected with simultaneously towed 0.20 and 0.61-meter bongo samplers fitted with 0.505 and 0.333-millimeter mesh nets. Bongo tows are double-oblique, surface to near bottom, or to a maximum depth of 200 meters. Vessel speed will be adjusted during each tow to maintain a 45° wire angle. Bridge officers will monitor a wire angle indicator to regulate ship's speed.

The Northeast Fisheries Center will provide scientific equipment and a variable speed winch for use on Polish ships. The Center will also provide equipment required to assure that Canadian survey activities in the Gulf of St. Lawrence are compatable with U.S./Polish operations. Ships are expected to be equipped with electricity (110 AC) and on-deck facilities to successfully complete ichthyoplankton survey operations. Survey operations will be carried out on a 24-hour day^{-1} basis. Scientific personnel will be on duty for 12 hours each day.

U. S. scientists/technicians working on Polish and Canadian ships are responsible for quality control of all logs filled out on their watches to

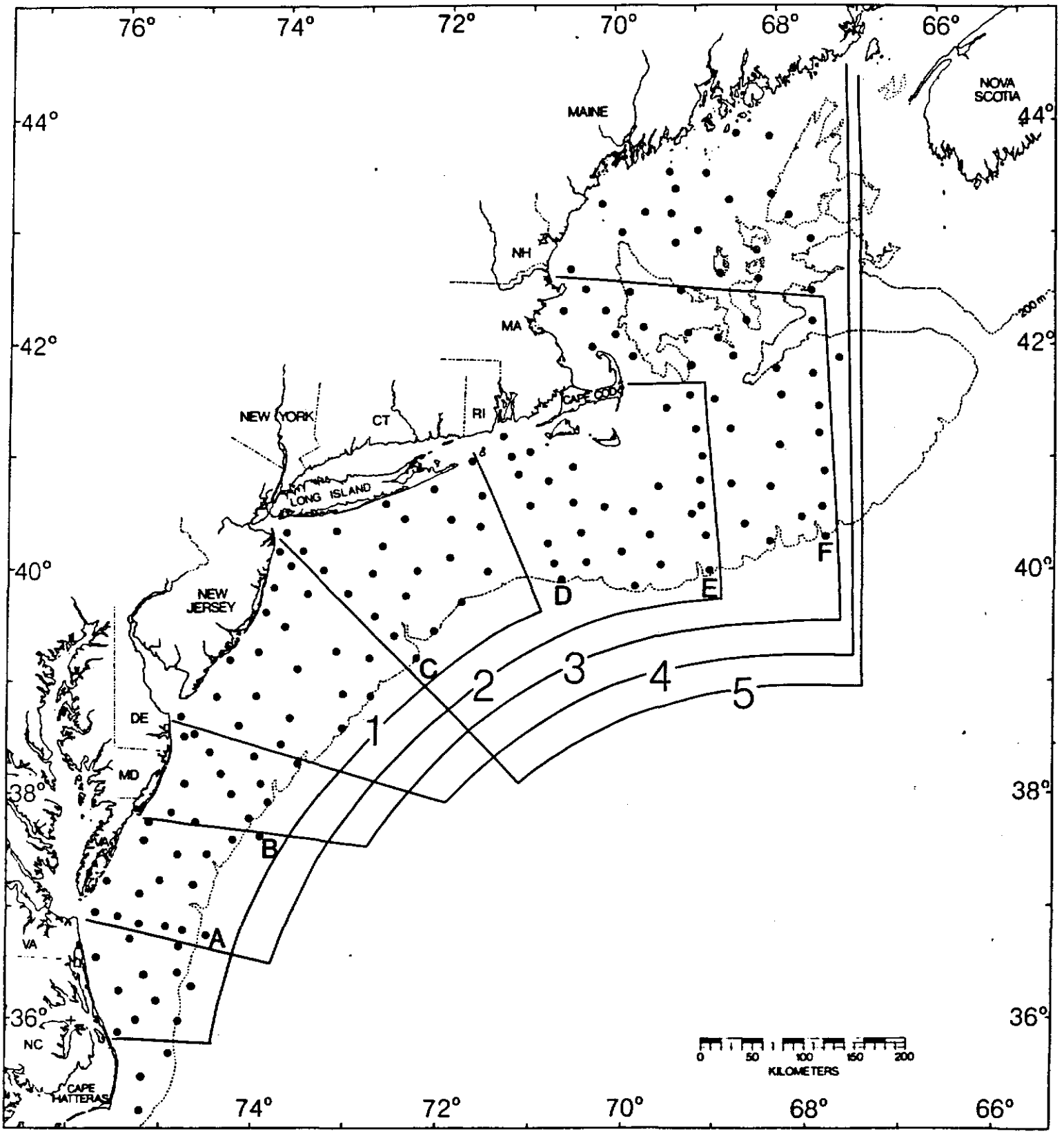


Figure 1. Sampling areas for five BIOMAC cruises to collect Atlantic mackerel eggs off northeastern United States during spring/summer 1987. Areal coverage will extend beyond boundaries shown in figure if mackerel eggs are observed in samples from easternmost stations. Cruise 1--Arciszewski, April 13-24: Cruise 2--Delaware II, May 4-22: Cruise 3--Wieczno, May 27-June 13: Cruise 4--Wieczno, June 15-July 1: Cruise 5--Wieczno, July 3-15.

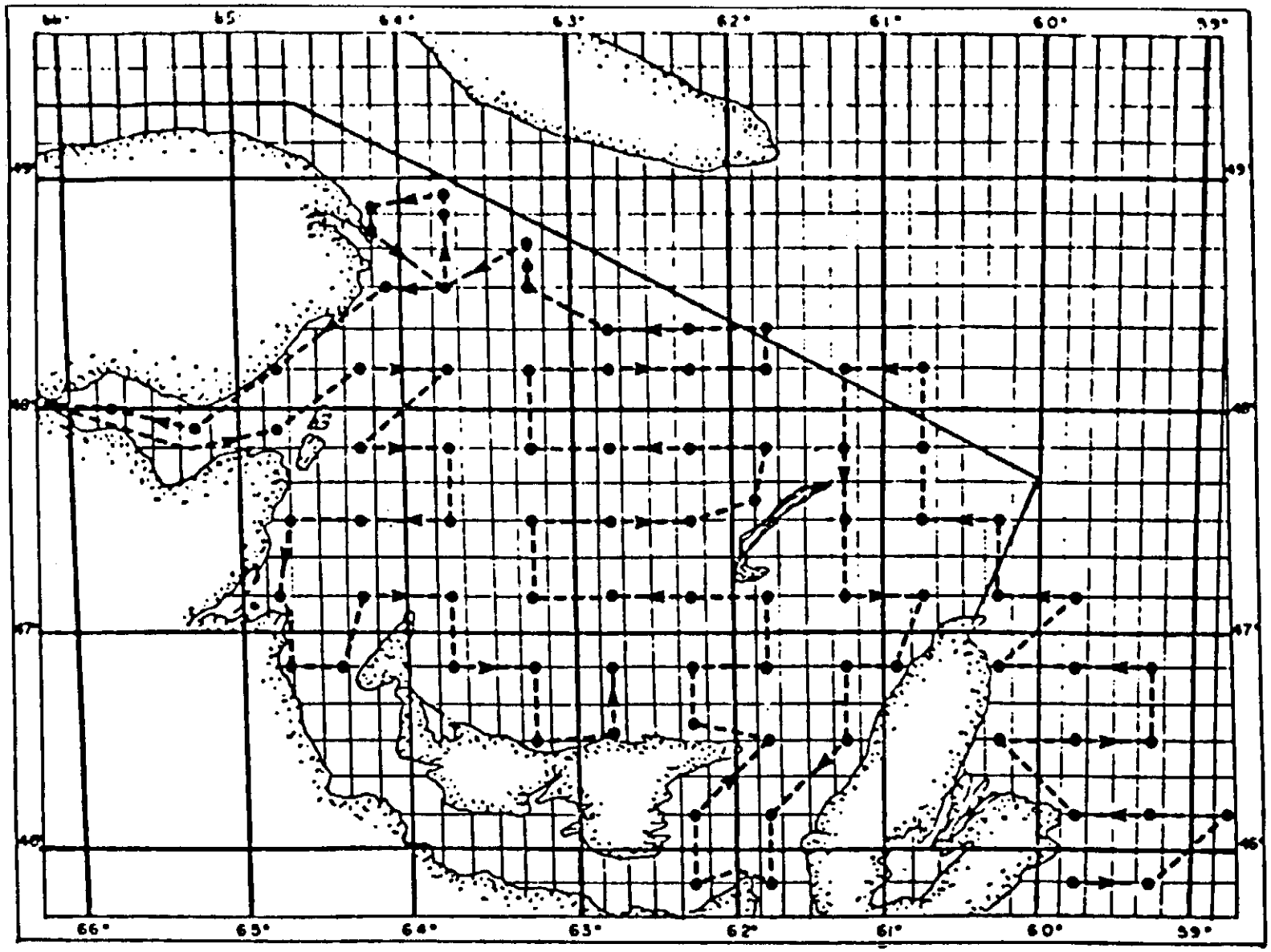


Figure 2. Canadian survey plan for sampling Atlantic mackerel eggs in Gulf of St. Lawrence, late June - early July.

assure they are complete and accurate, and for their delivery to the Ichthyoplankton Assessment Investigation at Sandy Hook within one week of cruise completion. The senior U. S. scientist/technician is responsible for the proper storage of samples at sea, handling during offloading and delivery within 3 working days of cruise completion to Narragansett for creating and shipment to the Zaklad Sortowania i Oznaczania Planktonu (ZSIOP), Szczecin, Poland.

DISPOSITION OF DATA: Samples from the 0.20-meter bongo will be crated for immediate shipment for Zaklad Sortowania i Oznaczania Planktonu (ZSIOP), Szczecin, Poland, for sorting, identification, staging, and enumeration of mackerel eggs. Egg and accompanying data sheets will be returned by airmail to Northeast Fisheries Center Sandy Hook Laboratory within three weeks of receipt at ZSIOP. Adult spawning biomass of Atlantic mackerel will be derived by biologists in the Ichthyoplankton Assessment Investigation. Temperature information will be recorded in analysis-ready format at sea and copies forwarded through the senior U. S. scientist/technicians to the Ichthyoplankton Assessment Investigation at Sandy Hook within one week of cruise completion. Salinity samples will be analyzed at Woods Hole. Hydrographic measurements will be forwarded to National Oceanographic Data Center (NODC), Washington, D.C. Shipboard data relating to continuous underway fluorometry measurements will be available from the Sandy Hook Laboratory. A cruise report will be prepared by the senior U. S. scientist/technican within 30 days of disembarking.

GENERAL INSTRUCTIONS FOR LABORATORY PROCESSING OF OVARIES

1. Remove ovaries from thawed females and store for 1 week or until well hardened in 10% formalin solution. Do not crowd ovaries in preservative.

2. After hardening occurs, slit open the ovary and separate the eggs by gently crumbling the eggs apart.

3. Wash the eggs over a 0.09 mm sieve to eliminate all the small eggs and leave a clean sample of all the eggs 0.10 mm and greater.

4. Weigh the entire egg sample and randomly select five subsamples for measuring and counting.

5. Weigh the subsamples individually and calculate an average count per milligram for each subsample. The sample should contain between 1000-2000 eggs for easy processing. Experience with subsampling is needed to obtain a sample that can be counted in a reasonable time.

Egg diameter frequencies from subsamples are used to define the appropriate "stage" of egg development for inclusion in the final fecundity estimates. In general, the investigator can tell, after some experience with the ovaries, which ovaries should be eliminated before initiating the subsampling process.

CYTO-EMBRYOLOGICAL AND GENETIC STUDIES OF ATLANTIC MACKEREL

BACKGROUND: Studies of Atlantic mackerel eggs collected in plankton in the New York Bight in the mid 1970s showed higher mortality, more cytogenetic abnormality, more developmental malformation at both the cell and gross level, and lower development rate in more pollution-impacted waters than in lesser impacted areas. Frequencies of somatic mutation measured in both circulating blood cells and in immature erythrocytes of the head kidney of adult fish are in agreement with the trend for cytogenetic abnormality of eggs to be higher in more polluted coastal waters. Overall, mortality and abnormality decreased as development advanced. Analysis of corresponding mackerel egg, analytical chemical and physical data sets from 10 sample sites in 1977 and 10 in 1978 revealed strong statistical association between the biological and environmental data sets. However, neither pollution nor temperature/salinity alone could account for this association.

Preliminary analyses of 1979 MARMAP collections of mackerel eggs indicates that abnormality of development, mortality, and cytogenetic error may all have been less outside the New York Bight. However, gastrula embryos seem to have had a high general incidence of gross malformation over the entire spawning range though somewhat less outside the Bight. Such malformations were mostly absent in 1974 when recruitment was outstanding, but present in 1977 and 1978 samples taken in the New York Bight.

OBJECTIVES: As part of BIOMAC, we will conduct further studies on cytogenetic abnormalities on Atlantic mackerel eggs. These cyto-embryological studies will include coastal waters from North Carolina to the Gulf of St. Lawrence to test the hypothesis that pollution in combination with temperature/salinity influences the viability and normalcy of mackerel egg development over the entire spawning range of the populations with the implication that recruitment could be largely from outside the New York Bight.

In addition to the above, the proposed sampling strategy should allow us to simultaneously test the hypothesis that temporal genetic adaptation to oceanographic conditions is the prime determinant of annual recruitment variability. Testing this hypothesis requires that ripe eggs be stripped from fish representing an assortment of age classes, and that these be fertilized and incubated for about 2 hours at 3 different temperatures. Sub-samples of the eggs or gonads from the same fish will be frozen for DNA analyses. Plankton will be sampled in the same area/water mass from which fish were taken.

SAMPLING METHODS: The standard MARMAP plankton samples from U. S. waters and Canadian plankton samples from the Gulf of St. Lawrence will provide eggs for cyto-embryological studies. In addition, we will culture eggs from adults taken within the two areas i.e., the New York Bight and the Gulf of St. Lawrence. The eggs of 20 ripe females of as wide a size distribution as possible will be fertilized by similar-size males in an effort to sample all ages within each area. Three hundred to 600 eggs of each female will be cultured in separate containers, 100 to 200 at each of 3 temperatures (ambient sea surface, +4° and -4° of the ambient temperature) after being stripped and fertilized at those temperatures. The same females used for egg cultures will be sampled for mitochondrial DNA anlaysis. The numbers of fish finally analyzed for DNA, and from which egg samples will be scored cytologically will depend on age determinations of the fish used for culture. Interacting effects

of chemical pollution on genetic fitness can be measured by sampling the gonads or eggs of the same females used for culture studies.

Analyses will include examination of the cause-effect relationship between cultured egg viability and normalcy at different temperatures in the two areas; the statistical relationship between this and planktonic egg viability/normalcy; genotype of the cultured fish; age of fish; contaminant burden of their ovaries; and temperature/salinity of the water mass. Genotypes of aged, mature and immature fish will be compared. All new data will also be considered in relation to earlier cyto-embryological and related studies of mackerel eggs, and in relation to inter-annual variability as determined from analyses of 10 years of MARMAP samples. The approximately 20 adult females used for egg culture at each of the generally designated areas must be of as wide size range as possible. Cultures are to be fixed when eggs reach the 32 to 64 or so cell stage, or have been allowed sufficient time to reach this stage. Label samples as to water mass, male and female used in the cross, culture time and date; or the sample can simply be given a number with all essential data entered into a record book.

Otoliths and/or scales are to be taken from each fish used for culture as well as for each selected fish which fails to yield ripe eggs. Length and weight will be determined on all fish, and a portion of the ripest part of the gonad preserved. The same fish will be examined for general maturation state, and also for any gross lesions as fin rot, ulcers, and liver tumors.

Ripe, stripped eggs or, in the absence of these, the ripe portions of the gonad, will be frozen for DNA analyses.

ATTACHMENT I

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole, Massachusetts 02543

9 January 1987

SAILING ORDERS

POLISH F/V ADMIRAL ARCISZEWSKI

CRUISE 87-01 (I-V)

and

POLISH F/V KULBIN

CRUISE 87-01 (I-V)

Atlantic Mackerel Research Fishery

TO: MASTER AND CHIEF SCIENTISTS
POLISH F/V's ADMIRAL ARCISZEWSKI AND KULBIN

The ADMIRAL ARCISZEWSKI and KULBIN will proceed on or about 16 January 1987 from Boston, Massachusetts, to conduct an Atlantic Mackerel Research Fishery in the waters of the continental shelf between Georges Bank and Cape Hatteras. The KULBIN will arrive on the fishing grounds on or about 20 January 1987 and will work in tandem with the ADMIRAL ARCISZEWSKI. The project will terminate on or before 29 May or 8 June 1987 and will be divided into five parts. The suggested itinerary is specified in the attached Cruise Instructions, dated 2 January 1987.

Allen E. Peterson, Jr.
Center Director
Northeast Fisheries Center

16 January-10 February:	Conduct the research fishery as described in operational plans.
10 February:	Arrive Brooklyn, NY and debark U.S. scientific personnel.
Part II:	On or about 12 February-10 March 1987.
12 February:	Embark U.S. scientific personnel and depart Brooklyn, NY to continue the research fishery.
12 February-10 March:	Conduct the research fishery as described in operational plans.
10 March:	Arrive Brooklyn, NY and debark U.S. scientific personnel.
Part III:	On or about 12 March-7 April 1987.
12 March:	Embark U.S. scientific personnel and depart Brooklyn, NY to continue the research fishery.
12 March-7 April:	Conduct the research fishery as described in operational plans.
7 April:	Arrive Brooklyn, NY and debark U.S. scientific personnel.
Part IV:	On or about 9 April-5 May 1987.
9 April:	Embark U.S. scientific personnel and depart Brooklyn, NY to continue the research fishery.
9 April-5 May:	Complete the research fishery as described in operational plans.
5 May:	Arrive Brooklyn, NY and debark U.S. scientific personnel.
Part V:	On or about 7-29 May or 7 May-5 June 1987.
7 May:	Embark U.S. scientific personnel and depart Brooklyn, NY to continue the research fishery.
7-29 May or 7 May-5 June:	Conduct the research fishery as described in operational plans.
29 May or 5 June:	Arrive Boston, MA and debark U.S. scientific personnel.

Data Management: Trawl catches will be sampled aboard as specified in the Operational Plans. Final processing of trawl logs will be done at the NEFC Laboratory at Woods Hole. Biological samples will be distributed to and processed by the appropriate NEFC groups. Biological samples collected by Polish scientists will be analyzed at the Morski Instytut Rybacki, Gdynia, Poland. Copies of all data logs will be provided to both USA and Polish scientists.

Ichthyoplankton samples will be delivered to ZSIOP, Poland for volume determinations, sorting identification and enumeration of fish eggs, larvae and invertebrates. Fish eggs and larvae data will be sent for analysis to the NEFC Laboratory at Sandy Hook, New Jersey.

ROSCOP II Form (NOAA Form 24-23) will be submitted to the National Oceanographic Data Center (NODC), Washington, D.C. within 30 days following completion of the cruise. The cruise results for the vessel will be submitted to NEFC, Woods Hole within 30 days following completion of the cruise.

Communications: Radio contact between ADMIRAL ARCISZEWSKI and KAC Woods Hole will be at 0830 local time (daily) on a frequency of 2613 kHz. Radio contact between ADMIRAL ARCISZEWSKI and KUBLIN via VHF will precede the call to KAC, Woods Hole. In the event that communications cannot be made via KAC, the marine operator may be utilized.

Watches: Due to the nature of the work, vessel operations will be 24 hours per day. U.S. scientific personnel will work a minimum of 12 staggered hours.

Equipment and Supply Lists: All trawl gear will be furnished by the ADMIRAL ARCISZEWSKI and KUBLIN. The ADMIRAL ARCISZEWSKI must be equipped with a variable speed hydrographic winch capable of maintaining speeds from 5 to 50 meters per minute. All ichthyoplankton gear will be furnished by NEFC. Trawl and plankton logs, measuring boards, beam scales, fish baskets, specimen bags and containers, jars, labels, formalin and other supplies, as needed, will be provided by NEFC.

Personnel List (Scientific):

Part I: 16 January-19 February 1987.
ADMIRAL ARCISZEWSKI: Roger Clifford
KUBLIN: F. Austin Farley

Part II: 12 February-10 March 1987.
ADMIRAL ARCISZEWSKI: not designated at present
KUBLIN: Scott McNamara

Part III: 12 March-7 April 1987.
ADMIRAL ARCISZEWSKI: Roger Clifford
KUBLIN: Cathleen Drew and Janet Hess

Part IV: 9 April-5 May 1987.
ADMIRAL ARCISZEWSKI: Ellen Johnson and Doris Finan
KUBLIN: Arthur Neill

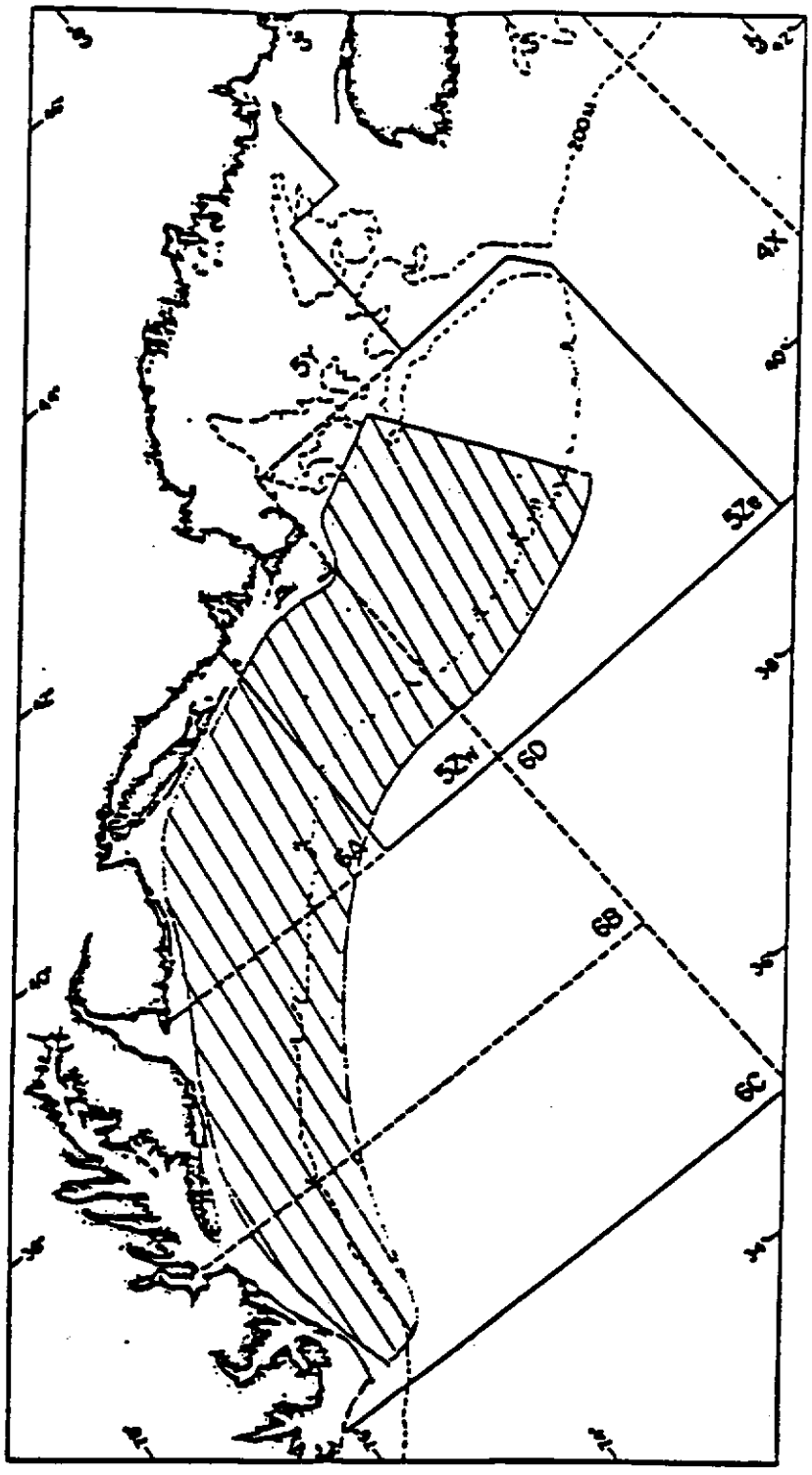


Figure 1. General area of activity for Polish F/V's ADMIRAL ARCISZEWSKI and KULBIN Cruise 87-01 (I-V) Atlantic Mackerel Research Fishery, during 16 January-22 May or 5 June 1987.

ADMINISTRATIVE SUPPLEMENT TO CRUISE INSTRUCTIONS

F/V's ADMIRAL ARCISZEWSKI and KULBIN: Cruise 87-01 (II) Atlantic Mackerel Research Fishery. Scheduled departure on 12 February 1987; scheduled return on 10 March 1987

In accordance with the Northeast Fisheries Center's Operational Policy: Hours of Duty and Pay for Center Personnel at Sea, dated 02 October 1978: The following duty schedule and hours of work are authorized for the listed scientific personnel.

Duty Schedule.

Personnel. Personnel listed below are authorized scheduled tours of duty and overtime in conformance with Center policy.

Name	Laboratory
Scott McNamara	NMFS, NEFC, Woods Hole, MA
Not designated at present	

Research Associates and Guest Workers. The following personnel are assigned to the subject cruise as Research Associates and/or Guest Workers. Tour of duty is without salary and per diem compensations; meal subsistence is authorized.

Funding. Cruise costs will be funded as follows:

	Organization Code Predetermined by	Task/Phase	Object Class
Overtime & Premium Pay	Employee's Duty Station	8L1A6B5	A 115X
Shipboard Per Diem	FS L200	"	A 2140
Shipboard Subsistence	FS L200	"	A 2515
Cruise-related Travel	FS L200	"	A 21+X

*Authorized per diem at the rate of $1.50/day to be paid from Imprest Fund at the termination of the cruise. Charge code is (Org/Task/Obj. Class) FSL200 8L1A6B5A 2140.

H C Boyar

H. C. Boyar
Scientific Vessel Coordinator

ADMINISTRATIVE SUPPLEMENT TO CRUISE INSTRUCTIONS

F/V's ADMIRAL ARCISZEWSKI and KULBIN: Cruise 87-01 (IV) Atlantic Mackerel Research Fishery. Scheduled departure on 9 April 1987; scheduled return on 5 May 1987.

In accordance with the Northeast Fisheries Center's Operational Policy: Hours of Duty and Pay for Center Personnel at Sea, dated 02 October 1978: The following duty schedule and hours of work are authorized for the listed scientific personnel.

Duty Schedule.

Personnel. Personnel listed below are authorized scheduled tours of duty and overtime in conformance with Center policy.

Name	Laboratory
Arthur Neill	NMFS, NEFC, Woods Hole, MA
Ellen Johnson	NMFS, NEFC, Woods Hole, MA
Doris Finan	NMFS, NEFC, Sandy Hook, NJ

Research Associates and Guest Workers. The following personnel are assigned to the subject cruise as Research Associates and/or Guest Workers. Tour of duty is without salary and per diem compensations; meal subsistence is authorized.

Funding. Cruise costs will be funded as follows:

	Organization Code Predetermined by	Task/Phase	Object Class
Overtime & Premium Pay	Employee's Duty Station	8L1A6B5 A	115X
Shipboard Per Diem	FSL200	" A	2140
Shipboard Subsistence	FSL200	" A	2615
Cruise-related Travel	FSL200	" A	214X

*Authorized per diem at the rate of $1.50/day to be paid from Imprest Fund at the termination of the cruise. Charge code is (Org/Task/Obj. Class) FSL200 8L1A6B5A 2140.

H. C. Boyar
Scientific Vessel Coordinator

General Instructions for Scientists/Technicians/Observers Aboard
ADMIRAL ARCISZEWSKI

1. You are participating on behalf of and representing the Northeast Fisheries Center in a cooperative research fishery for mackerel. The vessels are not operating under the set of regulations normally governing foreign trawlers. Observers: you are serving only as a scientist, and not as a foreign fisheries observer; you are not to be concerned whether the vessels comply or not comply with foreign fishing regulations.

2. The research fishery has been authorized to harvest up to 5,000 metric tons of mackerel plus any associated by-catch. This is not part of any TALFF. Any species caught may be retained and processed; for species other than mackerel, this will generally be minimal. Any marine mammals caught should be released as soon as possible.

3. If fixed gear is intercepted (very unlikely), the vessel should release the gear if it is likely that the gear was not dragged too far or damaged too much for the owner to recover it. If gear is severely damaged to the extent it would be lost if released, it should be held on board, identification marks, colors, numbers, etc. determined, and possibly brought back to port for return to the owner or so NMFS can compensate the owner for loss. In the unlikely event all of this happened, you should solicit instructions from Woods Hole via radio.

4. You will work in cooperation with the Polish scientist/technician aboard the vessel. The vessels are owned and operated by the GRYF Deep Sea Fishing Company in Szczecin. The scientists/technicians are from the Sea Fisheries Institute in Gdynia.

5. You will have radio communication with KAC Woods Hole, Monday-Friday 08:30. KAC will speak only with the ADMIRAL . The ADMIRAL and KULBIN will speak prior to the 08:30 call each day.

6. A record of each trawl haul will be kept using NEFC survey logs. All data/information relevant to the tow should go on the log, including catch data as well as data on depth, position, temperature, weather, etc. obtained from the bridge. Refer to sample log for data to record.

7. The gross weight (in kilograms) of each species in the catch (round live weight) is recorded. The weight can usually be estimated initially and then revised later as production figures (converted back to live weight are provided by the factory manager (technolog) to the bridge log. Do your best to identify and estimate the weight of all by-catch species (see enclosed sample log for details).

8. Weigh and measure (fork length to nearest centimeter, kg to nearest tenth) two 2-bushel baskets of mackerel (usually 100-200 fish) from each tow. Weight of sample recorded on log is gross weight (including basket) (see enclosed sample log).

9. Take otoliths from one mackerel at each 1-centimeter length interval and place in scale envelope. **"Sample only every two days unless notified otherwise".** Do not crush these envelopes with rubber bands. Keep them loose. Record sexual maturity stage on scale envelope (Polish scientists will help.

10. Take length measurements from subsample of by-catch species as time permits. For River Herring follow instructions on enclosed memo.

11. Marine mammals and sea turtles: see enclosed manuals and instructions.

National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Foreign Fisheries Observer Program
Post Office Building
P.O. Box 1285
15 Dale Avenue
Gloucester, Massachusetts 01931-1285

3 February 1986 F/NER75:PG

TO: All Fisheries Compliance Inspectors and Program Staff

FROM: Patricia Gerrior
Foreign Fisheries Program Manager

SUBJECT: River Herring

Due to the increasing interest in river herring by-catch, especially in the mackerel fishery, it is necessary to refine our data collection and to expand our sampling efforts on river herring species. Both the Atlantic States Marine Fisheries Commission and the Regional Management Councils have requested observer river herring catch data and biological samples.

I am requesting henceforth that you identify all river herring to species (i.e. alewife, blueback herring, hickory shad, and American shad) and record the amount of each species caught and/or transferred on your data forms. This may necessitate subsampling river herring catches. If you subsample, please identify to species <u>all</u> fish in your subsample and then apply the percentage occurrence by weight factors to the total river herring catch.

For example, if you have five bushel baskets of river herring and you sample one basket of 50 kg. net weight. Identify and weigh all species in your sample. The results are:

Alewife - 25 kg.
Blueback herring - 20 kg.
American shad - 5 kg.

$\frac{25}{50}$ = .5 Alewife

$\frac{20}{50}$ = .4 Blueback herring

$\frac{5}{50}$ = .1 American shad

Apply the factors (.5, .4, .1) determined from your subsample to the total net weight of the five bushel baskets of river herring catch (266 kg.). Thus, you would record 133 kg. Alewife, 106 kg. Blueback herring, and 27 kg. American shad on your data forms for this catch of river herring.

Please review your fish reference materials for techniques to identify these fishes. One technique to separate alewives from blueback herring is to open the fish and to check the coloration of the stomach lining. Alewives have a pinkish colored stomach lining; bluebacks, a black or smoky colored stomach lining. Both species of shad have a row of approximately six spots extending back from the gill cover; whereas, blueback herring and alewives have only one spot. To differentiate between hickory and American shad, it is necessary to examine the mouth and jaw extension (reference - Don Flescher's Guide to Some Trawl Caught Marine Fishes From Maine to Cape Hatteras, North Carolina, NOAA Technical Report NMFS Circular 431; Bigelow and Schroeder; Breder, etc.).

Sampling requirements for these species are as follows:

Alewife and Blueback Herring
- sample catches of approximately 50 kg. and larger
- 100 randomly selected fish. Do not take separate alewife and blueback samples if the two species are caught together.
- length frequencies only
- record lengths separately by species

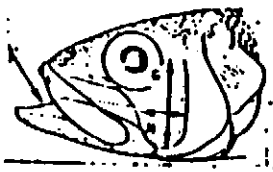
American and Hickory Shad
- sample shad catches of 100 or more fish
- 100 randomly selected fish. Do not take separate American and hickory shad samples if the two species are caught together.
- length frequencies and otolith samples from American shad (2-3 otolith samples/cm interval)
- length frequencies only from hickory shad
- record lengths separately by species

If you have any questions about data collection and/or sampling procedures, please speak to me.

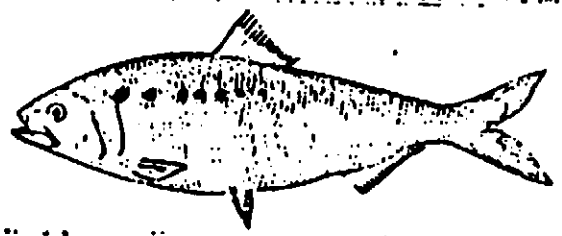
cc: D. Crestin
G. Shepherd
C. Landry

(continued from preceding page)

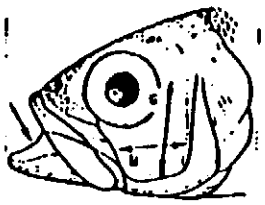
HERRING FAMILY (CONTINUED)



Upper outline of forward part of lower jaw nearly straight. Chest bone much higher (G) than long (H).

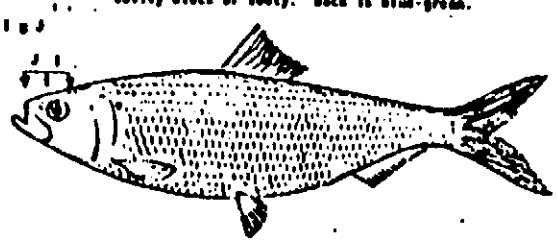


AMERICAN SHAD *Alosa sapidissima*
Maximum size: 2½ feet, 13½ pounds
Range: Newfoundland to Florida, and on the United States' Pacific coast.



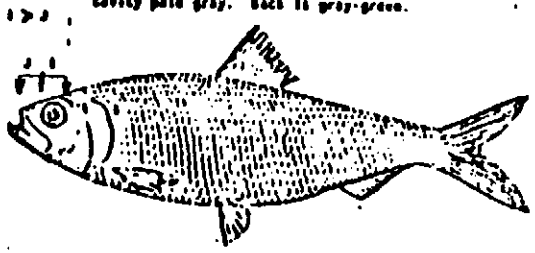
Upper outline of forward part of lower jaw with pronounced angle. Chest bone only slightly higher (G) than long (H).

Eye width (I) equal to distance from front of eye to tip of snout (J). Lining of belly cavity black or sooty. Back is blue-green.



BLUEBACK HERRING *Alosa aestivalis*
Maximum size: 15 inches
Range: Nova Scotia to Florida.

Eye width (I) greater than distance from front of eye to tip of snout (J). Lining of belly cavity pale gray. Back is gray-green.



ALEWIFE *Alosa pseudoharengus*
(Freshwater herring)
Maximum size: 15 inches
Range: Gulf of St. Lawrence to North Carolina.

RADIO MESSAGE

VESSEL: _____ CRUISE: _____ DATE: _____ HOUR _____

POSITION: _____ ° _____ LAT. N. _____ ° _____ LONG.W.

(Geog. Reference) AIR TEMP. _____ °C BAROMETRIC P. _____ millibars

SURFACE WATER TEMP. _____ °C

WEATHER CONDITION: _____ VISIBILITY _____ miles SKY: _____ % cloud cover

WIND DIRECTION: _____ VELOCITY: _____ knots SEA STATE _____ feet

ACTIVITIES SINCE LAST REPORT (Summarized): Completed station #'s: _____

Station #	Position (Lat., Long.)	Mackerel catch mt.	length range	modal length

OTHER MESSAGES: _____

XBT messages received and delivered to Woods Hole Coast Guard

RECORDED BY: _____

VIA: RADIO ( ) TELEPHONE ( )

STATION No. 1

IAL SAMPLES (O) Ovig. (F) Stom. (P) Parm. & others	LENGTHS OF INDIVIDUAL FISH (Centimeters) (< 8 individuals)	SPECIES Every other one when possible	SEX	SPP Code Number	WEIGHED PART OF CATCH (Circle basket portion measured) 1 Bushel (Gross Wgt)	2 Bushel (Gross Wgt)	Other (net)	Portion Discarded (Amount and Unit)	LF Expan Factor	TOTAL CATCH Weight	Number
17		MacKerel				52.5, 55.0				25300	
		Alewife								100	
		Silver hake								50	
		Spiny dogfish								400	

	MacKerel				
1			1	1	1
2			2	2	2
3			3	3	3
4			4	4	4
5			5	5	5
6			6	6	6
7			7	7	7
8			8	8	8
9			9	9	9
20			0	0	0
1			1	1	1
2			2	2	2
3			3	3	3
4			4	4	4
5			5	5	5
6	𝍸	5	6	6	6
7	𝍸 𝍸 III	13	7	7	7
8	𝍸 𝍸 IIII	14	8	8	8
9	𝍸 𝍸	10	9	9	9
30	II	2	0	0	0
1	II	2	1	1	1
2			2	2	2
3	III	3	3	3	3
4	III	3	4	4	4
5	𝍸 II	7	5	5	5
6	IIII	4	6	6	6
7	𝍸 𝍸 I	11	7	7	7
8	𝍸 𝍸 𝍸	𝍸 I 21	8	8	8
9	𝍸 𝍸 𝍸	𝍸 𝍸 𝍸 III 33	9	9	9
40	𝍸 𝍸 𝍸	𝍸 𝍸 𝍸 30	0	0	0
1	𝍸 𝍸 III	13	1	1	1
2	𝍸	5	2	2	2
3	I	1	3	3	3
4			4	4	4
5		177	5	5	5
6			6	6	6
7			7	7	7
8			8	8	8
9			9	9	9
0			0	0	0
1			1	1	1
2			2	2	2
3			3	3	3
4			4	4	4
5			5	5	5
6			6	6	6
7			7	7	7
8			8	8	8
9			9	9	9
0			0	0	0
1			1	1	1
2			2	2	2
3			3	3	3
4			4	4	4
5			5	5	5
6			6	6	6
7			7	7	7
8			8	8	8
9			9	9	9
0			0	0	0

h ☐ one check)

Volume in liters (40 liters = 1 bushel)

Sampling

* - Items to complete on Polish trawlers

CODING DETAILS FOR TRAWL LOGS
SEPTEMBER 1982
MODIFIED 9-29-03 MJS

ITEM	COLUMN	DESCRIPTION
* CRUISE CODE	1-4	4 DIGIT CODE, FIRST 2 ARE FOR THE YEAR AND SECOND TWO ARE SEQUENTIAL CRUISE NUMBER. NUMBER MUST NOT DUPLICATE ANY PREVIOUSLY USED DATA CODE NUMBER.
* STATION	5-8	4 DIGIT STATION NUMBER. THIS IS TO BE A SEQUENTIAL NUMBER WHICH WILL NOT BE REPEATED.
STRATUM	9-13	5 DIGITS, FIRST TWO ARE FOR STRATUM GROUP CODE NUMBER. THE NEXT TWO ARE FOR THE STRATUM NUMBER. THE FIRST (9) AND LAST (13) IS CODED 0. STRATUM GROUP CODE 01=OFFSHORE NORTH OF HATTERAS 02=NOT RANDOM,MIC. 03=INSHORE NORTH OF HATTERAS 04=YUY & SPAWING HADDOCK 05=SCOTIAN SHELF 06=SHELLFISH 07=INSHORE SOUTH OF HATTERAS 08=OFFSHORE SOUTH OF HATTERAS 09=STATE OF MASS.
TOW	14-16	3 DIGIT TOW NUMBER. FIRST DIGIT CODED ZERO. THIS IS TO BE THE NUMBER OF THE TOW TAKEN FROM THE CHART.
VALUES STN	17	1 DIGIT CODE FOR TYPE OF STATION. 1=SURVEY TOW; 2=SPECIAL TOW; 3=NOT USED AT THIS TIME; 4=COMPARISON; 5=NO TOW.
HAUL	18	1 DIGIT CODE FOR CONDITION OF HAUL. 1=GOOD TOW, NO GEAR OR TIME PROBLEM. 2=REPRESENTATIVE, BUT SOME PROBLEM ENCOUNTERED DUE TO GEAR OR TOW DURATION. 3=PROBLEM TOW MAY OR MAY NOT BE REPRESENTATIVE DUE TO GEAR OR TOW DURATION. 4=NOT REPRESENTATIVE, DUE TO GEAR OR TOW DURATION. 5=NO TOW

CODE FOR MINUTES OUT	TRAWL	TRAWL	SCALLOP	CLAM
1	30	15	15	5
2	26-29	11-14	11-14	4
	31-34	16-19	16-19	6-9

3	20-25	10	10	3
	35-40	20	20	10
4	<20 OR >40	<9 OR >21	<9 OR >21	<2 OR >11

IMPORTANT NOTICE! WHEN CODING HAUL VAULE AND THERE IS BOTH GEAR DAMAGE AND SHORT TOW DURATION, TIME CODE 2-4 WILL HAVE PRECEDENCE OVER GEAR DAMAGE CODE .

GEAR CONDITION 19

1 DIGIT CODE FOR GEAR CONDITION.
1=NO DAMAGE TO INSIGNIFICANT DAMAGE! SCOPE + OR - 15%.
[CODE 1 FOR HAUL COLUMN 18 OR TIME CODE 2-4]

2=WING TWISTED OR TEARS IN UPPER OR LOWER WINGS NOT EXCEEDING 10 FEET! TEAR IN SQUARE NOT EXCEEDING 5 FEET! TEARS NOT EXCEEDING 3 FEET IN UPPER BELLY, OR 6 FEET IN LOWER BELLY! COD END OR LINER WITH TEARS NOT EXCEEDING 2 FEET! PARTED IDLER! DREDGE LINER WITH MODERATE TEARS! SCOPE + OR - 16-30%.
3=HUNG UP MINOR DAMAGE.
[CODE 2 FOR HAUL COLUMN 18 OR TIME CODE 3-4]

4=PARTED LEGS, SWEEP OR HEADROPE! BROKEN BLADE! DREDGE RING BAG BROKEN OR MISSING SEVERAL RINGS AND OR LINER DESTROYED! CLUB FOOT DETACHED.
5=TEAR UP EXCEEDING LIMITS FOR CODE 2, BUT NOT TOTAL.
6=OBSTRUCTION IN TRAWL SUCH AS FIXED GEAR, ROCKS, OLD ANCHORS, TIMBERS, ETC.(PROBLEM INDICATED BY THIRD WIRE), UNMATCHED DOORS, STRONG CURRENT! SCOPE > 30%.
[CODE 3 FOR HAUL COLUMN 18 OR TIME CODE 4]

7=CROSSED DOORS, DREDGE TURNED OVER, VERY STRONG CURRENT.
8=OPEN GEAR! PUMP MALFUNCTION.
9=MAJOR HANG UP! TOTAL TEAR UP! LOSS OF ALL GEAR! LOSS OF TRAWL! LOSS OF ONE OR BOTH DOORS, DREDGE LOST OR TOTALLY DAMAGED.
[CODE 4 FOR HAUL COLUMN 18]

STAT AREA 20-22

3 DIGIT CODE FOR STATISTICAL AREA USED FOR COMMERCIAL DATA.

VESSEL 23-24

2 DIGIT CODE WITH VESSEL NAME WRITTEN ON SOLID LINE.
VESSEL CODES ARE! AL=ALBATROSS IV! DE=DELAWARE II, FE=FRANCIS ELIZABETH! GM=GLORIA MICHELE! WZ=WIECZNO

CRUISE 25-26

2 DIGIT VESSEL CRUISE NUMBER STARTING WITH 01 FOR FIRST CRUISE OF YEAR. PREVIOUSLY RECORDED WITH YEAR, THEN CODE NUMBER.

EST=(1)
EDT=(2) 27

1 DIGIT CODE FOR EASTERN STANDARD TIME = 1, OR DAYLIGHT SAVINGS TIME = 2. IF 2 IS RECORDED IN BOX THEN TIME WILL HAVE TO BE CORRECTED TO EST, BY SUBTRACTING ONE HOUR. THEN CHANGE 2 IN BOX (27) TO 1.
[EDT STARTS THE LAST WEEK IN APRIL AND ENDS THE LAST WEEK IN OCTOBER]

R-MO-DA	28-33	6 DIGIT, FIRST 2 WILL BE YEAR, NEXT 2 WILL BE MONTH AND LAST 2 WILL BE DAY. THIS DIFFERS FROM EARLIER FORMAT WHICH HAD DA-MO-YR.
EAR TYPE	34-35	2 DIGIT CODE USED FOR TYPE OF GEAR. 11=STANDARD SURVEY 36 YANKEE 12=SANDY HOOK LAB 3/4 YANKEE TRAWL 14=SANDY HOOK LAB SMALL BAY TRAWL 16=SANDY HOOK LAB 36 YANKEE WITH CHAIN SWEEP 39=STATE OF MASS TRAWL 41=MODIFIED 41 YANKEE 80=8' SCALLOP DREDGE UNLINED 82=8' SCALLOP DREDGE LINED 90=10' SCALLOP DREDGE 91=4' CLAM DREDGE 92=5' CLAM DREDGE 99=FOREIGN TRAWL
IME	36-39	4 DIGIT MILITARY TIME IN LOCAL TIME. LATER CORRECTED TO EST BEFORE DATA IS ENTERED INTO SYSTEM.
N OUT 1)	40-42	3 DIGITS FOR TIME OUT OF GEAR WITH 1/10 OF MINUTES USED FOR CERTAIN TYPES OF GEAR.
P START END	43-50	8 DIGITS FIRST 4 FOR DEPTHS AT START OF TOW IN METERS AND LAST 4 FOR DEPTH AT END OF TOW IN METERS.
N-MAX	51-58	8 DIGITS, FIRST 4 FOR MINIMUM DEPTH IN METERS AND LAST 4 FOR MAXIMUM DEPTH IN METERS. SHOULD BE TAKEN FROM BOTTOM TRACE, IF NO BOTTOM TRACE THEN USE START AND END DEPTH. NOT USED FOR SHELLFISH SURVEY.
AT LONG	59-66	8 DIGITS, FIRST 4 FOR BEGINNING LATITUDE ROUNDED TOWARD END POSITION AND LAST 4 FOR LONGITUDE ROUNDED TOWARD BEGINNING OF TOW.
ORAN	67-98	32 DIGITS FOR BEGINNING AND ENDING LORAN BEARINGS. BEGINNING DIGIT IS TO DESIGNATE THE STATION TYPE, WITH THE LETTERS W, X, Y, OR Z. THE NEXT 5 DIGITS IN EACH LINE IS THE BEARING, FOLLOWED BY A TENTH OF A MICROSECOND. THE LAST DIGIT IS LEFT BLANK.
ABLE	99-102	4 DIGITS FOR WIRE OUT IN METERS AT THE WATER SURFACE.
ITCH	103-105	3 DIGITS FOR USE WITH VARIABLE PITCHED PROPELLERS.
EADING	106-108	3 DIGITS FOR VESSELS HEADING IN DEGREES.
OURSE	109-111	3 DIGITS FOR THE ACTUAL COURSE THE VESSEL TOOK IN DEGREES. NOT USED DURING SHELLFISH SURVEY, CODE 000.
PM	112-114	3 DIGITS FOR ENGINE RPM WHILE UNDER TOW.

)OPPLER(.01))OTTOM	115-117	3 DIGITS FOR SPEED OVER BOTTOM. FIRST ONE IS A WHOLE NUMBER FOLLOWED BY 2 DIGITS FOR 1/100 OF A MILE.
/ATER	118-120	3 DIGITS FOR SPEED THROUGH THE WATER COLUMN RECORDED SAME AS OVER THE BOTTOM. NOT USED FOR SHELLFISH SURVEYS, CODE 000.
)ES SPEED (.1)	121-122	2 DIGITS FOR DESIGNATED TOWING SPEED FOR A PARTICULAR GEAR TO 1/10 OF MILE.
ID GEAR	123-124	2 DIGITS FOR IDENTIFICATION OF NETS, DREDGES, ETC.
)OORS	125-126	2 DIGITS FOR IDENTIFICATION OF PAIRED TRAWL DOORS. NOT USED FOR SHELLFISH SURVEY, CODE 000.
IEAD ROPE IT (.1M)	127-129	3 DIGITS WITH THE LAST ONE TO 1/10 OF A METER FOR HEIGHTS OF HEADROPE FROM BOTTOM WHEN RECORDING HEADROPE TRANSDUCER MEASUREMENT. NOT USED FOR SHELLFISH SURVEY, CODE 000.
OTHER GEAR	130-133 130-131 132-133	TWO 2-DIGIT CODES TO LIST OTHER GEAR. PLANKTON - 01, HYDROGRAPHIC. 02 CODES TO BE ASSIGNED.
AIR TEMP	134-136	3 DIGITS FOR AIR TEMPERATURE ROUNDED TO NEAREST FULL TEMPERATURE. COLUMN 134 CAN BE USED FOR NEGATIVE SIGN.
CLOUD COVER	137-138	2 DIGITS TO CODE FOR CLOUD COVER IN "OKTAS" 0=00 1 OKTAS OR LESS, BUT NOT ZERO=01 2 OKTAS=02 3 OKTAS=03 4 OKTAS=04 5 OKTAS=05 6 OKTAS=06 7 OKTAS=07 8 OKTAS=08 9 SKY OBSCURED, OR CLOUD AMOUNT CANNOT BE ESTIMATED (NIGHT, FOG,), MODIFIED 1-24-83, MJS THIS IS SAME AS MARMAP
INSOL.	139-142	4 DIGITS TO RECORD SUN'S RADIATION. FIRST DIGIT IS FOR CALIBRATION PURPOSE AND REMAINING 3 ARE FOR READOUT.
BAR(MB)	143-146	4 DIGITS TO RECORD BAROMETRIC PRESSURE IN MILLIBARS.
WIND DIR, SPEED	147-151	5 DIGITS TO RECORD WIND DIRECTION AND SPEED. IF NO WIND CODE 999 AND CODE 99 FOR SPEED.
WEATHER	152-153	2 CODE FOR WEATHER. 00=CLEAR (NO CLOUDS AT ANY LEVEL), 01=PARTLY CLOUDY (SCATTERED OR BROKEN)! 02=CONTINUOUS LAYER(S) OF CLOUD(S)! 03=SANDSTORM, DUSTSTORM, OR BLOWING SNOW! 04=FOG, THICK DUST

		OR HAZE) 05=DRIZZLE) 06=RAIN) 07=SNOW, OR RAIN AND SNOW MIXED) 08=SHOWER(S), 09=THUNDER-STORM(S)) 99=OBSCURE.
WAVE HEIGHT	154-155	2 DIGITS FOR HEIGHT OF WAVES TO .1 METER.
SWELL DIR. HT	156-160	5 DIGITS, FIRST 3 ARE FOR DIRECTION IN DEGREES AND LAST 2 ARE FOR HEIGHT TO .1 METER.
REF SURF TEMP	161-163	3 DIGITS FOR BUCKET SURFACE TEMPERATURE TO .1 DEGREE C. THE FIRST COLUMN CAN BE USED FOR A MINUS SIGN WHEN TEMPERATURE IS BELOW FREEZING. THE MINUS TEMPERATURE WILL NEVER BE LOWER THAN -9.9.
SURF SAL.	164-167	4 DIGITS TO IDENTIFY SURFACE BOX NUMBER (164-165) AND JAR NUMBER (166-167).
BOT SAL.	168-171	4 DIGITS TO INDENTIFY BOTTOM BOX NUMBER (168-169) AND JAR NUMBER (170-171).
SAL. DEPTH	172-175	4 DIGITS FOR DEPTH OF SALINITY SAMPLE TAKEN.
XBT	176	1 DIGIT CODE IF XBT WAS TAKEN. CODE 1
TEMP. SURF-BOT	177-182	6 DIGITS, FIRST 3 ARE SURFACE AND LAST 3 ARE BOTTOM. TEMPERATURES ARE TO .1 DEGREE C.
CODED SPECIES	183-184	2 DIGITS FOR NUMBER OF SPECIES CAUGHT AND CODED FROM THE STATION. TREAT EACH SEX AS A DIFFERENT SPECIES.
TRASH	185-188	4 DIGITS FOR RECORDING THE AMOUNT OF TRASH IN LITERS.
FULLNESS OF DREDGE	189-191	3 DIGITS. USED FOR SHELLFISH SURVEYS ONLY.
SEDIMENT TYPE	192-194	3 DIGITS. SHELLFISH SURVEYS ONLY.
TRASH BY %	195-203	9 DIGITS FOR TRASH BY % FOR SHELLFISH SURVEYS ONLY.
AVE DEPTH	204-207	4 DIGITS FOR AVERAGE DEPTH BETWEEN START AND END TOW.
CALC SPEED	208-210	3 DIGITS FOR THE CALCULATED SPEED OF THE TOW FROM THE DOPPLER TO .1 NAUTICAL MILE.
RADIATION	211-213	3 DIGIT FOR CORRECTED RADIATION VALUE FROM COLUMNS 140-142.
SURF SAL	214-218	5 DIGITS FOR SUFACE SALINITY.
BOT SAL	219-223	5 DIGITS FOR BOTTOM SALINITY.
TOTAL WEIGHT	224-229	6 DIGITS FOR TOTAL WEIGHT OF SPECIES FOR STATION(.1KG).
TOTAL NUMBER	230-235	6 DIGITS FOR TOTAL NUMBER OF ANIMALS FOR STATION.

WEATHER

Code	
00	Clear (no cloud at any level)
01	Partly cloudy (scattered or broken)
02	Continuous layer(s) of cloud(s)
03	Sandstorm, duststorm, or blowing snow
04	Fog, thick dust or haze
05	Drizzle
06	Rain
07	Snow, or rain and snow mixed
08	Shower(s)
09	Thunderstorm(s)
99	Obscure

CLOUD TYPE

Code	
00	Cirrus
01	Cirrocumulus
02	Cirrostratus
03	Altocumulus
04	Altostratus
05	Nimbostratus
06	Stratocumulus
07	Stratus
08	Cumulus
09	Cumulonimbus
99	Obscure

CLOUD AMOUNT
(Est. more or less)

Code	
00	Clear
01	10%
02	20%
03	30%
04	40%
05	50%
06	60%
07	70%
08	80%
09	90%
10	100%
99	Obscure