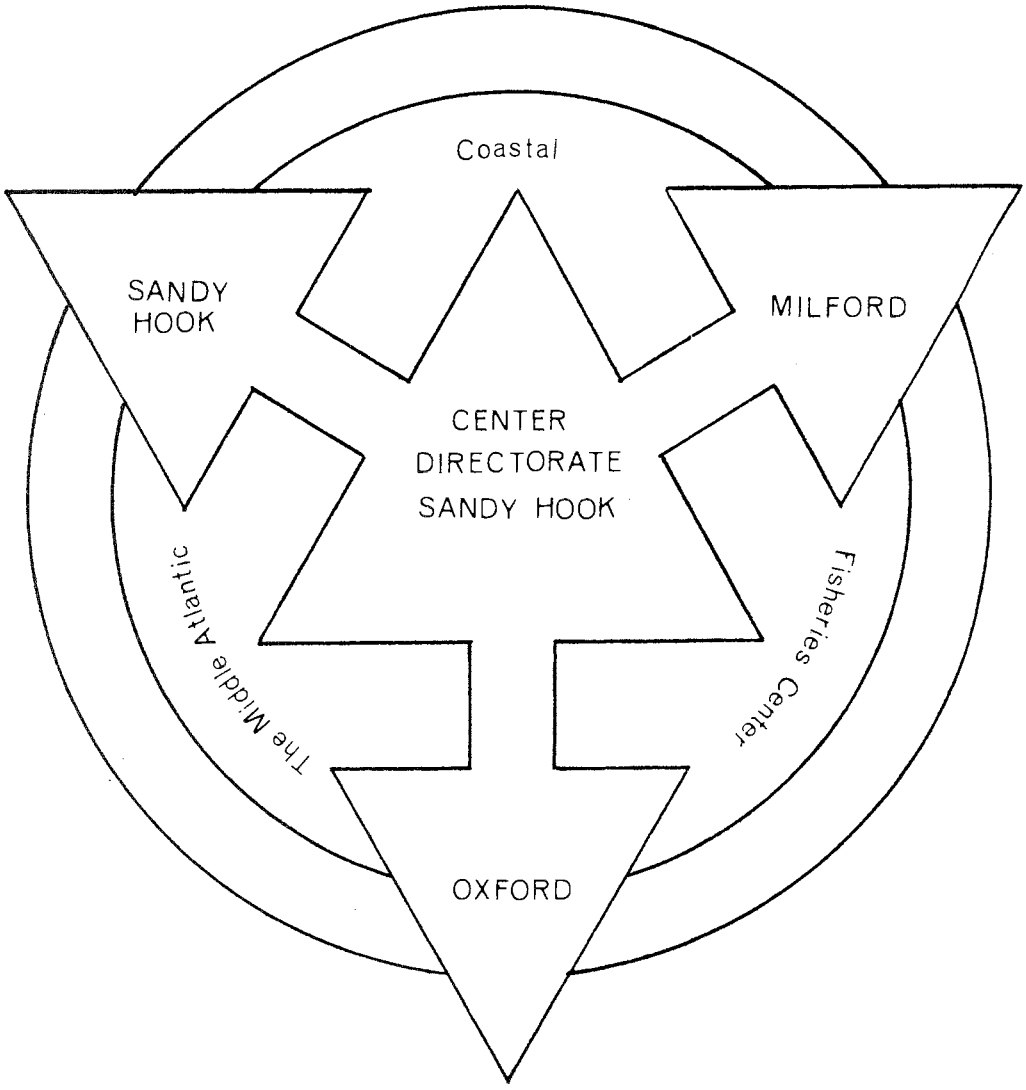
A MULTILABORATORY COOPERATIVE STUDY OF CONTAMINANTS IN THE COASTAL ENVIRONMENTAL AND LIVING MARINE RESOURCE

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



Informal Report No. 1-A

June, 1972

A MULTILABORATORY COOPERATIVE STUDY OF CONTAMINANTS IN THE COASTAL ENVIRONMENT AND LIVING MARINE RESOURCES

(TRIAL OPERATIONS MARCH 1 TO JUNE 30, 1971)

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NOTE:

The analytical findings reported herein are administratively restricted and are not to be published in any form.

SYNOPSIS

A multilaboratory cooperative study of contaminants in the marine environment and related effects in aquatic organisms was initiated in the later part of FY 71 as a preliminary to a long range on-going study. Each laboratory was assigned a lead responsibility, although this assignment was not meant to be exclusive of other interests in the study areas. Two major operations were involved -- a general survey for mercury levels in organisms collected on the MARMAP ground fish survey (hereafter termed the "Piggyback" study), and a broader study of many contaminants such as heavy metal ions, pesticides, plasticizers, and similar materials on selected target species in specific waste disposal sites within the New York Bight (hereafter termed the Dump site study). Three sewage or sludge disposal sites were selected for comparisons with three uncontaminated control sites.

The Ground fish survey involved about 45 days, separated into 3 legs, in March and April, and the Dump site coastal cruises involved monthly 1 or 3-day cruises along the coast. In each case numerous samples of fish, invertebrates, water and sediments were obtained for heavy metal, microbiological, radionuclide, and pathological examinations. In the Dump site study extensive benthic samples were also obtained for ecological studies of suspected contaminated areas.

As a trial operation, the program was quite successful. Some problem areas were identified and suggestions made for their resolution in an on-going study. The move of the Ann Arbor analytical laboratory will cause a serious delay in processing the sample materials. Coordination of the multilaboratory activity is essential to a viable study, and a coordinator should be selected at an early date.

The contaminant study will continue through the early months of FY 72, and final plans for the on-going program will be established in September following reorganization of the participating laboratories.

INTRODUCTION

A cooperative venture involving several NMFS Biological Laboratories to study contaminants in marine systems of the northeast and middle Atlantic coasts was initiated in the spring of 1971 with the following objectives:

1. Delineate the contaminant levels (with particular emphasis on mercury) in living marine resources and their environment.
2. Determine the specific effects of waste disposal areas (i.e., ocean dump sites) in concentrating harmful contaminant materials.
3. Determine the pathological and physiological effects of contaminants on selected, typical marine organisms.
4. Develop a multilaboratory cooperative approach to the study of these problems and the essential methodology to conduct a long-range contaminant program.

The ultimate goal of the long-range study was to identify the impact of contaminants in relation to the abundance and distribution of living marine resources, to provide essential baselines for regulatory enforcement, and to provide specific information to balance waste disposal and economically valuable resources.

This report describes the initial efforts of a multilaboratory study for the months of March, April, May, and June; the accomplishments; the problems encountered; and recommendations for an on-going program in FY 72. The cooperating laboratories and their areas of specific responsibility and more general interest are listed below:

Ann Arbor: Major responsibility for chemical analyses and for microbiological studies of the environment.

Oxford: Responsibility for all pathological studies and for microbiological studies on or in the living organism, and for collecting target species at Chincoteague.

Sandy Hook: Major responsibility for ecological studies of dump sites and control sites along the New York and New Jersey shore.

Milford: Responsibility for collecting target species at sites in Long Island Sound, and for laboratory experiments in physiological and genetic stress for selected marine species.

Beaufort: Radionuclide analyses--possible pesticides and similar materials in future.

ACCOMPLISHMENTS

"Piggyback" Study Using MARMAP Groundfish Survey

Twice in each year (spring and fall), the Woods Hole Biological Laboratory undertakes a comprehensive survey of the groundfish resources over the Continental Shelf from Nova Scotia to Cape Hatteras. This survey is conducted from the RV ALBATROSS IV and requires about 45 days of ship operations, divided into three legs or cruises.

Personnel from the cooperative contaminant study were placed aboard the ALBATROSS on the following schedule to obtain tissues for mercury (Hg) analyses and pathological examination:

March	Oxford	Martin Newman
	Ann Arbor (Pascagoula)	Richard Hamilton
March to April	Oxford	Darryl Christensen
	Milford	Ed Rhoades
April	Oxford	Jerry Hendricks

Samples were obtained and processed according to the protocol described in Appendix A and the specimens obtained are listed in Appendix B.

Thirty-seven species of fish and 8 species of invertebrates were collected on these cruises and additionally plankton and sediment samples were obtained. Well over two thousand tissue samples were prepared for chemical and pathological analyses.

Dump Site Study

This phase of the cooperative contaminant study was undertaken to measure the levels of contaminants in waste disposal areas; the concentration of these contaminants in marine organisms; the pathological and physiological responses to contaminant stresses, and the effects of contaminants as a limiting factor for living marine resources.

Six sites, three control sites and three waste disposal sites, were selected for intensive study. These sites are:

1. A dredge spoil disposal site near New Haven Harbor in Long Island Sound.
2. An adjacent uncontaminated control site.
3. The sewage disposal site, near the entrance to New York Harbor, which has been the subject of investigation by Sandy Hook Laboratory for the past two years.
4. An uncontaminated control site near the center of the surf clam fishery at Barnegat Light.
5. A sewage disposal site near the mouth of Delaware Bay.
6. A control site near Chincoteague, Virginia.

These areas are identified on the chart attached as Appendix C.

1. Field Samples -

Faunal, sediment, and water samples were collected from these sites at approximately monthly intervals in the last quarter of FY 71 following a comprehensive protocol (appendix D). An initial exploratory cruise was undertaken for 10 days in March, by Sandy Hook's RV CHALLENGER, over the New York, Barnegat, and Delaware sites. This provided an opportunity for individuals of the cooperating laboratories to become more familiar with the area, to obtain an early cross-section of the fauna, and to refine sampling techniques. The results of this cruise are detailed in Appendix E. Nearly 300 specimens were obtained from 11 species of animals, 103 surface drifters and 100 sea-bed drifters were released, 20 benthic faunal samples were obtained on the Delaware site, and numerous water and sediment samples with associated physical-chemical observations were taken. Based

on our experience from this initial study, monthly 3-day cruises, using RV DOLPHIN, were completed in April, May, and June over the three sites. Particular emphasis was placed on completing the benthic faunal sampling at Delaware Bay, and obtaining specimens of three target species (windowpane flounder, rock crab, and surf clam) at each location. The details of monthly cruises are given in Appendix F and G.

Concurrent with our exploration of the New York-New Jersey sites, studies of the Chincoteague control site were undertaken by Oxford personnel using the chartered fishing vessel MV CYNTHIA. During March, a series of day cruises were completed offshore from Chincoteague Inlet.

Subsequently, monthly cruises were completed in April, May, and June to three stations offshore of Chincoteague Inlet, where specimens of the target species were obtained. Additionally baseline samples of many marine organisms were taken to expand our knowledge of normal histology (appendix H).

At Chincoteague ocean stations the three target species have been obtained during each monthly cruise and processed for heavy metal analyses and for pathological examination. In addition, some 200 tissue samples have been taken to establish a histological baseline for "normal" pathology and parasites. Species of fish and invertebrates, other than target species, were sampled as available for additional heavy metal and histological analyses. During these one-day ocean cruises, about 17,000 individual fish, from about 42 species, and 2,400 invertebrate specimens, from about 13 species, were examined for gross signs of pathology and parasites. Morphometric data and fish scales for growth and age information were obtained.

The Milford Laboratory was given lead responsibility to select a waste disposal site and control site in Long Island Sound, and to undertake similar sampling programs as in other areas. It was proposed that Milford's RV SHANG WHEELER be used for the survey. Because of a limited staff and the necessity to obtain sampling gear, these exploratory contaminant cruises in Long Island Sound were not undertaken until early in June. An exploratory cruise was taken early in June to test gear and survey organisms in the area of interest. Subsequently, a sampling cruise was undertaken with successful operations in obtaining the target fish and crustacean species. Since the target mollusk (surf clam) does not occur in Long Island Sound an alternate clam will be selected to meet similar criteria as established for other target species.

2. Laboratory Studies -

Tissue samples from all field operations were sent to the Ann Arbor Technological Laboratory for chemical analyses. Mercury analyses were given first priority, with selected samples considered for immediate assessment of a broader array of heavy metals. The dump site samples were given priority over the ground fish survey samples, in order that identified high levels of contaminants within animals or their organ systems could guide pathological examinations toward the potentially most productive areas. The results of all chemical analyses to date are given in Appendix I. Eventually, we expect to analyze for a series of about 12 heavy metals.

The uncertainty of the Ann Arbor move to Milford has constricted analytical capacity, and the actual physical move, when and if it occurs, will further limit chemical processing of the samples. This problem will be discussed in more detail later in this report.

Microbiological studies of the environment are the responsibility of the Ann Arbor staff. These studies present somewhat unique problems, since field samples require skilled personnel, and subsequent analytical procedures require complex apparatus, highly-trained scientific talent, and operate within a limited time frame. Because of uncertainties in the Ann Arbor situation and personnel problems, only two field sampling operations were undertaken in FY 71 contaminant studies. One microbiological sampling sequence was completed on the first leg of the ALBATROSS groundfish survey, and the second sequence was completed on the June DOLPHIN cruise. Mr. Hamilton's critique of the microbiological effort on the ALBATROSS cruise is attached as Appendix J and will be discussed later in this report.

In both cruise efforts, the microbiological observations were mostly confined to simple surveys for coliform bacteria as a pilot model for future work. The results of these studies were not available for inclusion in this report.

Laboratory experiments at Milford were directed toward the evaluation of physiological stress induced by contaminants in the environment. Initial studies concentrated on the effects of heavy metal ions on the development and viability of fertilized oyster eggs. Ten ions have been used in the challenge experiments; mercury, silver, copper, zinc, nickel, lead, cadinuim, chromium, aluminum, and arsenic. Oyster embryos were found to be most sensitive to mercury (lethal at .008 ppm) followed by silver (.02), copper (.2) and zinc (.5). These experiments will be continued to establish LD_{50} levels and will also challenge other life history stages of an array of aquatic organisms. In addition, the tests will eventually be conducted at

a range of environmental levels (temperature and salinity) and with various combinations of heavy metals to define possible synergistic effects. These toxicity studies require numerous replicate experiments, and particularly with microscopic materials, such as oyster eggs, measurement and appraisal of individual organisms is generally limited by the number of aid or technician level personnel available.

At Oxford, laboratory studies for the contaminant project were advanced in two directions; establishment of baseline histological "norms" for organisms from uncontaminated environments, and intensive tissue examinations to identify pathological conditions in organisms from any area. In the former work, tissues of as many organ systems, from as many species as possible are obtained and prepared for microscopic examination. A team of comparative pathologists, with experts in fish, crustacean, and molluscan pathology, critically survey these histologic preparations to determine normal cellular morphology. With an established level of proficiency in recognizing normal tissue structure, tissues from suspect areas can be examined for the possible pathological changes that may result from environmental stress. The mere labor and routine processing requirements for this project are extensive and most work to date has involved taking tissue samples from all sources and putting them through the histological process of embedding, sectioning, mounting, and staining. Some 500 tissue blocks, representing about 12 organ systems, have been so prepared during this initial trial period of FY 71. Expert examination of these tissues is now underway.

The Sandy Hook Laboratory has had an active program in oceanic and estuarine ecology, and for the past several years has concentrated studies on the sewage dump site near New York Harbor. This past experience has already proven valuable for the cooperative contaminant study in that the equipment and methodology for ecological studies on the dump and control sites were immediately available for sampling regimens in the New York Bight region. On the CHALLENGER and DOLPHIN cruises, previously described, great emphasis was given to obtaining 0.1 m^2 Smith-McIntyre grab samples from a 49-station grid centered on the Delaware dump site. Additionally, grab samples were obtained at the Barnegat control site.

Laboratory examination of these samples and initial appraisal of the faunal associations are summarized in Appendix K.

Laboratory experiments are also underway at Sandy Hook to expose selected species of fish and crustaceans to the actual sludge materials dumped at the New York site. These experiments are conducted in closed aquaria systems and the experimental animals will be closely examined for development of pathological conditions.

The Center for Estuarine and Menhaden Research at Beaufort, North Carolina, has agreed to examine tissue samples from selected aquatic organisms (emphasizing sequential trophic levels) for radionuclides. The samples were collected during the period of the trial cooperative study but will not be processed until early in FY 72. If high radionuclide levels should be found in these organisms, we expect that a more concentrated sampling program will be established in the on-going study.

PROBLEMS

The cooperative contaminant study in FY 71 was specifically oriented toward tests of a functional system of operation and to identify the problem areas that must be resolved before a smoothly integrated program could be undertaken. The initial study was highly successful in these objectives.

"Piggyback" Survey

The full cooperation of the Woods Hole Laboratory is gratefully acknowledged. Their scientific staff and the crew of the ALBATROSS IV were most helpful in guiding our people through the difficulties of planning for an embarking on unfamiliar ocean cruises. The problems encountered on shipboard were minimal and were largely physical limitations of space and stability, with the one major exception of the incompatibility of microbiological studies.

From the viewpoint of the contaminant study the following problem areas were identified:

1. Cruise personnel: The original plans were developed to share the obligation for staffing the ALBATROSS cruises equally among the participating laboratories. In actual operations, however, most of the load fell on the Oxford Laboratory. This situation did not result from reticences on the part of laboratories to staff cruises but was attributable to understaffing and complications of the Ann Arbor situation. The problem can be easily resolved by advance planning. At the June meeting of cooperators in the study, the

cruise obligations were specifically defined as one man on each leg of the fall groundfish survey; i.e., a person from Milford on one leg, Ann Arbor on one leg, and Oxford one leg. Allocation of the assignments might be on the basis of laboratory interest; for example, Oxford would be most interested in the southern section of the survey (Block Island to Cape Hatteras) for the fish life in this region, Milford in the Georges Bank section, and Ann Arbor in the Gulf of Maine section because of the availability of suitable bottom sediments for microbiological studies.

2. Space: It was our impression from the spring cruises that the groundfish surveys are being used extensively for other projects such as ours. This of course provides maximum use ofthe vessel operations, but it also means that the availability of space and space assignments are most critical. It is a problem that can be resolved by planners at Woods Hole, but must be clearly defined in advance.

3. MARMAP Plankton Samples: On the spring survey, six plankton samples were frozen for mercury analyses (two samples from each leg of the cruise). Only two of these samples have been analyzed for mercury at this time with very low levels (about .05 ppm) found. It has been subsequently suggested that materials from the MARMAP Ichthyoplankton Surveys be analyzed for heavy metals (not just mercury) and for pathology. It should be understood at the outset that this is a tremendous undertaking, not only for the chemical

analytical requirements which must be made on plankton sorted to genus, or preferably species, but more critically for the pathological examinations which must be made by highly-trained scientists on individual tissue by tissue, slide by slide, microscopic observations. Additionally, there is little, if any, information available on the normal histology of these organisms (we are only now acquiring this information for our common, economically valuable, adult fishes), and this phase of investigation alone would require a high level of funds and staff. With these limitations in mind, it was agreed at the June meeting that only selected plankton samples (preferably from monospecies collections, or less ideally from carefully sorted material at the Boothbay sorting center) would be submitted for heavy metal analysis and for pathological examination. Initially the numbers of these samples must be severely limited in order that analyses of higher priority, such as economically valuable fish and crustaceans, will not be delayed. Since plankton samples for contaminant and pathological examination require special handling (i.e., no fixatives for chemistry - should be frozen; special fixatives for histology) a separate protocol should be developed for processing these materials from the point of collection to the point of analyses. The protocol will be developed by planktologists at Boothbay in cooperation with Oxford and Ann Arbor staff.

4. Microbiological Studies: The limitations imposed by the special requirements of this study discipline are difficult to resolve. The microbiological survey of sediments and water, planned for the groundfish survey cruise, requires that a trained scientist be aboard with specialized equipment (such as incubators, culture media, etc.) to culture micro-organisms as obtained. Samples must be obtained using special aseptic samples, and they cannot be fixed, preserved, or frozen. Therefore, it was generally agreed at the June meeting that the microbiologist survey on the groundfish cruises might be delayed until the Ann Arbor staff is adequately set up at Milford and has the proper equipment (perhaps a mobile lab) available to undertake such a study. As pointed out in Mr. Hamilton's critique (appendix J) and restated at the June meeting, microbiological studies may not be compatible with the prime interests of the groundfish cruises. The proposed delay in microbiological studies should be definitely affirmed before the fall groundfish survey, and it should be understood that the Ann Arbor staff will continue to have a commitment for one person on one leg of the cruise to meet contaminant obligations.

Dump Site Study

Problem areas in the dump site study were expected and were found to be numerous, but were easily identified. In general, for a first approach to a multilaboratory effort the four months of operations went surprisingly smooth and all involved should be congratulated for the excellent accomplishments

made during this period. The following problem areas were specifically identified:

1. Cruise schedules: The Long Island Sound and the Chincoteague cruises were easily scheduled and completed. The monthly DOLPHIN cruises were more complex and require careful attention to cruise plans and scheduling. Assuming that the cooperative contaminant study will continue through FY 72, three-day cruises should be scheduled for the DOLPHIN for every month in the year, not later than the next-to-last week in each month. Thus, if the schedule should be delayed by weather or other factors the cruise could still be taken in the following or final week. Details of the entire cruise (i.e., cruise track, stations to be sampled, number of people, number and kinds of sample stations and gear) should be circulated well in advance and opportunity provided for each investigator to assure that any special apparatus, facility, or space required for his interests will be available.

2. Cruise Personnel and Related Factors: As all who have been aboard well know, the DOLPHIN is a difficult vessel on which to live and work. Therefore, good planning and adequate staffing are essential to smooth operation of the contaminant program. The significant problem areas center around space to work, inadequate or unavailable service facilities, insufficient crew to properly handle sampling gear, and unacceptable conditions in quarters. The subject of

insufficent crew was discussed at the June meeting and it was agreed that for an on-going program at least one additional fisherman position should be established in FY 72. Inadequate service facilities may be corrected by reworking existing vessel systems or by the use of mobile, self contained units placed on board. The concept of packaged or van-type laboratories might work out very well in this case. The quarters should be improved immediately if presently used staffing is continued. Bunks should be built in the forecastle, proper ventilation installed, sound-proofing materials installed, and perhaps an additional shower and toilet provided. There should be no necessity for scientific staff to sleep on air mattresses and sleeping bags (if sleep is even possible with the high noise levels), nor should they be forced to sleep on deck or benches elsewhere on the vessel because the quarters are improperly ventilated. These simple changes should not be exorbitantly expensive and will greatly add to the comfort of our staff.

3. Surf Clam Samples: Considerable difficulty has been experienced in obtaining routine monthly clam samples from each site, even though we have had excellent cooperation from interested fishermen and other parties. On the DOLPHIN cruises it would appear most practical to equip with a "rocker or jumper" dredge, a standard clam gear used in the southern New England area, to obtain the samples directly on the vessel and to immediately process them

by experienced personnel. At the Chincoteague site, an uncontaminated control area, clams will be obtained from commercial fishermen. In the Long Island Sound area probably some other species of clam will be selected (surf clams are not available) and suitable gear must be obtained for the SHANG WHEELER. These suggestions for clam sampling should be implemented as soon as possible.

4. Other Sampling Problems: The originally established sample protocol has generally worked satisfactorily. Some practical changes have been initiated under actual practice and these revisions are incorporated into the protocols appended to this report. There are several recommendations that have been made for further changes and these should be considered by all cooperators at the next general meeting. One specific problem relates to the amount of tissues necessary for chemical analyses. Whenever multi-element analyses are expected to be performed on a sample (usually dump site samples; usually target species) a minimum of 75 to 100 grams of tissue should be obtained and a 200 gram sample would be most desirable.

5. Sample Distribution: There have been no major problems in this area, but a flow diagram has been prepared (appendix L) for future reference.

6. Analytical Capacity: Under the conditions that have existed since the inception of the contaminant study, the Ann Arbor analytical section have done a remarkable job in keeping up to date on the dump site

samples. They have been unable to process the "piggyback" samples. With their eminent move to the Milford complex this summer all further heavy metal analyses will be delayed until the analytical section can be re-established. Alternate actions to acquire analyses during this period would be to immediately contract with a private research laboratory, or to delegate analytical responsibility to another Federal laboratory. As was pointed out in the June meeting, timely analytical results are essential if biological anomalies are to be related with environmental contamination. Therefore, it is of great urgency that arrangements be made for continuing chemical analyses during the next several months.

In addition to problems with heavy metal analyses, no firm arrangements have been made for chemical analyses of pesticides, plasticizers (PCB), or other contaminants. If the study is to be effective in measuring environmental stress on resource abundance and distribution, concentrations of these materials in marine organisms must be assessed at an early date.

7. Experimental capacity: One of the most promising methods to establish a cause and effect relationship between pathology and environmental contaminants is through the conduct of carefully controlled laboratory experiments. From the outset of the cooperative contaminant study, it was planned that physiological studies would be undertaken on mollusks, crustaceans, and fish (at various life history stages) challenged against heavy metal ions

and other selected contaminants. Initial experiments used the eggs of oysters because the hatchery "system" had been developed for these economically important animals. Similar systems will have to be refined for other mollusks, crustaceans and fish. Some systems may not be available for development to the point where they are "fool-proof" and work must move ahead rapidly to isolate those species that can be used as early test organisms. Although the Milford Laboratory has the lead responsibility in this project, laboratory water quality may require that some species (for example, oceanic fishes) must be held at localities where water of particular characteristics is available. Milford will determine the priority for these studies and the availability of holding and experimental facilities in other laboratories.

In addition to establishment of toxic levels, chemical and pathological examinations should be made on challenged organisms. The numbers of animals used is so large that a systematic method of sub-sampling will be required in order that the analytical systems will not be overloaded.

8. Pathological Analyses: Problems with this phase of study were minimal and centered around the limitations imposed by the requirements of lengthy processing and individual subjective examination. As in some other phases of the contaminant study, more trained people means more rapid examination. Dump site samples have been

given highest priority for examination, since these organisms are suspect of having the most exposure to contaminants with the possibility of pathological results.

General Problems

1. As perhaps with any wide-spread multifacility operation, communication was a central problem during the trial period and will need constant attention in the future. The cooperative contaminant study must have a single person assigned the responsibility of coordinating the various activities of the study and to assure the free flow of materials and information between laboratories. Coordination could be accomplished through the office of the Center Director or by establishing a new position (Regional) for these duties. With the submission of this report the pro tem coordinator's assignment is terminated and it is imperative to the success of the on-going study that a permanent coordinator be selected immediately.

2. The contaminant study will generate a mass of data that should be organized and tabulated for ADP use. A prime responsibility of the project coordinator should be to establish the capacity and requirements for data archiving in the Regional facility at Woods Hole and to develop a uniform system for the entire cooperative study.

3. One of the major interests in the contaminant study is the concentration of contaminants in organisms and tissues through biological pathways. To properly understand these factors, it is critical that organisms be correctly identified taxonomically, since even closely related species may have different metabolic systems. The NMFS Center for Systematics at the Smithsonian Institution will assist in this phase of the study to provide a reference collection of certified identifications. In order to assure that these taxonomic studies will be undertaken, the program coordinator must make arrangements with the cooperating facilities involved with sample collections, so that suitable specimens will be reserved for taxonomy. The coordinator should also ascertain that cooperating laboratories are using standard nomenclature and codes for the animals under study.

RECOMMENDATIONS FOR FUTURE PROGRAM

At the June meeting of cooperators, the on-going program for FY 72 was discussed at great length. Recognizing that many decisions for the study hinged on resolutions of the Milford-Ann Arbor situation, it was agreed that the study would be continued, essentially as in the past, for the next several months. During this period consideration should be given to the problem areas identified in this report. Another meeting of cooperators has been tentatively scheduled for mid-September, when several aspects of the study can be firmed up and final plans for the on-going program established.

APPENDIX A

COORDINATED GROUNDFISH - CONTAMINANT STUDY
("PIGGYBACK STUDY")

The purpose of this program is to assess the levels of heavy metal ions, particularly mercury, and pathological changes in various fish, crustacean, and molluscan species as captured by the routine, or specially supplemented, sampling equipment used in the MARMAP-groundfish resource assessment cruises. Samples will be retained where possible so that more extensive analyses may be made in the future.

The groundfish survey will use the Albatross IV during the spring of 1971. Tentatively, this period has been allotted as (1) up to 18 days for the Gulf of Maine, (2) up to 18 days for Georges Bank south to Nantucket and Long Island, and (3) up to 11 days from Long Island south to Cape Hatteras.

The cooperating laboratories are expected to furnish staff assistance on the following schedule:

Oxford	= 1 person, 18 days 1 person, 11 days
Ann Arbor	= 1 person, 18 days
Milford	= 1 person, 11 days
Woods Hole	= possibly staff assignment for Gulf of Maine segment of cruise based on earlier cruise results

The sampling protocol at each station will be as follows:

Woods Hole requires for the groundfish survey a 30-minute trawl sample, a 15-minute oblique plankton tow, and an XBT cast.

Additionally, we need:

a) Faunal Samples

1) Fish: The National Marine Fisheries Service has established a national list of species to be analyzed for mercury and other toxic element contamination. Most of these specimens will be obtained from ports as landed. The groundfish survey provides an opportunity to sample the living populations at sea, and from past experience about 10 species may be encountered in the spring cruise; however, we hope for more than this minimum number. At the first opportunity 10 specimens of the same year class of each species encountered will be obtained. In some cases all specimens will come from a single haul, and this is most desirable; in others the specimens may only be acquired after several stations in the same strata. For mercury analyses, liver and muscle tissues will be examined and these tissues will be obtained according to the mercury sampling protocol appended. Samples of the same muscle and liver will be preserved in Davidson's Fixative for pathological studies at Oxford. This procedure will result in a minimum of about 200 tissues for mercury analysis and 200 for pathological study. At the discretion of pathologists on the vessel, additional organs may be sampled.

One additional fish specimen from the same sample population will be obtained whole and preserved in 10% formalin in a plastic bag for future taxonomic study. Later the specimen will be transferred to alcohol.

It is expected that heavy metal concentrations are most likely to be found in long-lived survivors at the top of the food chain. From past cruise data one such species, the dogfish, will be found at several different strata. This animal should be taken at no more than 2 strata on each major leg of the cruise to give a maximum total of 6 stations. The 5 additional 10-specimen samples of 2 tissues each would give (5 x 10 x 2) 100 mercury analyses and 100 pathological samples.

Woods Hole personnel routinely dissect fish for stomach analyses. In cooperation with our staff all fish showing gross pathological conditions will be reserved. Some conditions are commonly found, according to past experience, and a maximum of 10 specimens would be adequate for this preliminary study.

It is critical that all pertinent data regarding each individual specimen be retained throughout the study. Specimen labels according to the attached protocol should be used, and it is mandatory that a log book be established.

2) Invertebrates: It is difficult to predict how many invertebrate species may be encountered, particularly since a trawl will be the standard collecting gear. We should try for a selection from several trophic levels, if practical. Assuming that we might possibly find 6 species x 10 specimens = 60 analyses for mercury and 60 specimens for pathological study. The first 10 specimens will be shipped whole for mercury analysis, and additional specimens will be preserved in Davidson's Fixative for pathological studies.

b) A sediment sample from 6 stations over the entire groundfish survey area. Two samples will be obtained in the Gulf of Maine sector (strata 37 and 47), 2 samples in the Georges Bank sector (strata 10 and 16), and 2 samples from the middle Atlantic sector (strata 2 and 65). These samples can be obtained by a sediment "snapper" provided by Oxford. Samples for mercury analysis will be placed in plastic bags and frozen for subsequent processing at Ann Arbor.

c) Plankton samples will be provided by Woods Hole personnel at 6 stations over entire groundfish survey area. Samples will be obtained on same general plan as outlined in (b) above, and from the same stations. Samples will be frozen in plastic bags and an homogenate of the entire sample will be analyzed for mercury (i.e., 6 analyses). No water samples are required during this preliminary study.

d) When Ann Arbor microbiologist is aboard vessel he will obtain sediment samples as required for microbiological survey. This may require use of the Smith-McIntyre grab or some other instrument, but possibly the "snapper" may prove adequate.

Close coordination and precise records will be required if the results of this survey are to be meaningful. Modifications in the sampling plan may be required from practical experience, but the general protocol should be adequate for this survey.

SAMPLING PROTOCOL FOR MERCURY ANALYSES

Handling of Samples

It is imperative that samples are handled in a way that no metals will be introduced into the sample to be analyzed. Whenever possible the samples should be placed on plastic covered surfaces or wooden surfaces for work-up.

Samples Needed

I) Finfish

a) Pathology samples

A portion of liver and a portion of muscle should be removed from each finfish individual obtained for mercury analysis and preserved in Davidson's Fixative.* To assure adequate fixation these portions of tissue should not exceed 1 cc in volume. It is essential that the individual fish be processed as rapidly as possible so that post-mortem changes in the tissues do not occur. If the fish are too small for routine dissection under field conditions then 10 individuals other than those taken for mercury may be preserved whole, trimmed in such a way that the liver and a portion of the muscle will be retained and fixed. After 24 hours samples should be transferred to 70% ethyl alcohol. Tag numbers should correspond to the following mercury samples.

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*Davidson's Fixitive (1 gal) stock solution
400 ml glycerin
800 ml com. formalin
1200 ml 95% alcohol
1200 ml 15% se water
add 1 part glacial acetic acid to 9 parts stock solution before using.

b) Mercury samples

1) Muscle - For fish roughly 2 pounds and over--cut a "steak" (cross-section cut) out of the front portion of the fish. After removing the head, cut about a 2-inch-long chunk off for the sample. This chunk can be packaged, tagged and frozen. For fish under 2 pounds, remove a single fillet. Fish too small to dissect should be frozen whole and packaged individually

2). Liver - After removing the pathology sample where applicable, place the remainder of the liver in a plastic bag, tag it and freeze it.

II) Invertebrates Ten individual animals are needed as per the finfish. Place the entire animal in a plastic bag, tag and freeze. (See statement page 3 for pathology samples.)

Tagging Procedure

Each individual animal or chunk of animal should be placed in a plastic bag and tagged with the specific code number and log reference as defined in the attached code sheet.

If possible, the best way to ensure the tag to be legible and minimize loss of the tag is to place the tag in a separate plastic bag. tie it off and then put it in the bag with the fish sample. If this cannot be done, tie the tag on the outside of the plastic bag. Use a heavy, strong tag to minimize loss.

Freezing

It is very important that the samples are frozen solid in a relatively short time (several hours) and maintained in a solid frozen condition to prevent spoilage. Often with freezers on-board ship it is easy to overload

the equipment by placing too much "warm" material in the freezer at once; this can result in spoilage. Try to freeze small batches at a time to ensure proper freezing. Samples can be held under refrigeration (36-38°F) for 1 or 2 days prior to freezing if this is required.

INSTRUCTIONS FOR COLLECTION AND HANDLING OF MARINE SPECIES FOR MERCURY ANALYSIS

1. Information Required for Log Book

a) Identification code number

b) Date of capture

c) Precise area of capture (Loran or other)

d) Scientific and common name (American Fisheries Society nomenclature)

e) Tissue sampled

f) Fork length

g) Weight

h) Sex

i) Name of collector

j) Other information as indicated on log sheet (sample sheet appended)

2. Storage and Shipping Procedures

a) Samples (whole fish, fillets, steaks, meat pieces, or livers) are to be placed individually in polyethylene bags, tightly sealed and frozen immediately. "Whirl packs" are acceptable. Identification tags are to be placed in a separate sealed plastic bag and then placed inside the sample bag.

b) Samples should be placed in styrofoam containers along with an adequate supply of dry ice. If dry ice is not available, gel ice may be used.

c) All shipments should be sent collect by fastest route (air freight or REA air express) and are to be marked "Hold at airport," and also for airport to notify receiver (note telephone number on shipping container). No shipments are to be made on Thursday or Friday. After shipment has been made, call designated person at the laboratory and relay the following information to him concerning the shipment:

1) Airport

2) Airlines

3) Flight number

4) Time of arrival

5) Waybill number

3. Designated Recipients of Samples (until Ann Arbor move)

National Marine Fisheries Service
Ann Arbor Technology Laboratory
1451 Green Road
Ann Arbor, Michigan 48107
Phone: 313-769-7100
Attention: Mr. Robert Bruce or Mr. Richard Greig

APPENDIX B

Summary of Data for Samples Collected on the First Leg of the Albatross IV 1971 Spring Groundfish Survey

Species	Code No.	Fork Lm. (cm)	Location Lat.	Long.	Strata	tow	Date
Fish							
Yellowtail flounder	1A1/055/YF	27-34	41-12	71-17	5	5	10/III/71
Longhorn sculpin	1A1/055/LS	25	41-12	71-17	5	5	10/III/71
Ocean pout	1A1/093/PT	46	40-55	71-63	9	3	10/III/71
Sea herring	1A1/064/SG	20	40-23	71-02	6	4	10/III/71
Cod	1A1/051/CD		40-45	71-60	5	1	10/III/71
	1A1/052/CD	54-93	40-46	72-08	5	2	10/III/71
	1A1/053/CD		40-48	71-52	5	3	10/III/71
Red hake	1A1/065/RH	25-30	40-24	71-57	6	5	11/III/71
Fourspot flounder	1A1/065/FF	16-19	40-24	71-57	6	5	11/III/71
[illegible]	1A1/067/AW	20	40-32	71-20	6	7	11/III/71
Silver hake	1A1/065/SH	20	40-24	71-57	6	5	11/III/71
Spiny dogfish	1A1/067/DY	37	40-32	71-20	6	7	11/III/71
Windowpane	1A1/061/CM	30-35	39-59	71-40	6	1	11/III/71
Haddock	1A1/139/HK	46-68	41-01	67-06	13	9	16/III/71
Spiny dogfish	1A1/293/DY		42-17	66-34	29	3	21/III/71
Redfish	1A1/243/RD	38	41-42	69-16	24	3	24/III/71
Invertebrates							
Lobster	1A1/066/LR		40-25	71-20	6	6	11/III/71
Squid	1A1/072/SL		40-13	71-07	7	2	11/III/71
Horse mussel	1A1/191/MU		41-05	68-15	19	1	14/III/71
Pandalid shrimp	1A1/201/SP		41-19	61-20	20	1	23/III/71

Summary of Data for Fish Samples Collected on the Second Leg of the Albatross IV 1971 Spring Groundfish Survey

Species	Code No.	Fork Ln. (cm)	cons. tow no.	Location Lat.	Long.	Strata	tow	Depth (F.)	Date	Remar
Little skate	IA2/119/LE1-10[1]	45-50	119	40-57	71-18	5	6	29-30	30/III/71	A
Ocean pout	IA2/017/PT1-10	45-55	125	40-23	73-06	1	7	19-19	31/III/71	A
Yellowtail Flounder	IA2/015/YF1-10	28-32	126	40-16	73-24	1	5	19-20	31/III/71	A
Blueback Herring	IA2/692/BHL-10	10-12	140	38-08	74-40	69	2	16-18	2/IV/71	B
Atlantic Mackerel	IA2/663/CML-10	21	143	37-33	74-40	66	3	31-33	2/IV/71	B
Silver Hake	IA2/655/SP1-10	15-21	147	37-03	75-06	65	5	18-21	3/IV/71	B
Butterfish	IA2/651/BU1-10	10	151	36-37	75-20	65	1	14-16	3/IV/71	B
Spiny dogfish	IA2/614/SD1-10[2]	80-92	152	36-28	75-08	61	4	16-16	3/IV/71	A
Scup	IA2/621/SC1-10	17	157	36-00	74-53	62	1	41-44	4/IV/71	B
Striped Sea Robin	IA2/621/SR1-10	17	157	36-00	74-53	62	1	41-44	4/IV/71	B
Searobin	IA2/621/SE1-10	28-37	157	36-00	74-53	62	1	41-44	4/IV/71	A
Angel Shark	IA2/632/AS1-10	43-58	160	36-11	74-48	63	2	72-75	4/IV/71	A
Blackbellied Redfish	IA2/642/BL1-10	9-21	161	36-19	36-20	64	2	110-125	4/IV/71	B
Black Sea Bass	IA2/661/SB1-10	22-24	162	36-50	74-42	66	1	49-50	5/IV/71	A
Chain dogfish	IA2/663/CH1-10	17-25	163	36-59	74-37	66	3	95-130	5/IV/71	B
Dusky fish	IA2/671/BF1-10	13-14	164	37-07	74-33	67	1	87-98	5/IV/71	[illegible]
Spiny dogfish	IA2/712/DY11-20	82-95	173	38-14	73-44	71	2	70-70	8/IV/71	A
Gulfstream flounder	IA2/751/GF1-10	10-11	179	38-44	73-06	75	1	73-78	9/IV/71	B
Gray sole.	IA2/702/GS1-10[3]	31-36	172	38-13	73-51	72	1	100-170	8/IV/71	A

1. Should have read IA2/056/LE1-10
2. Should have read IA2/614/DY1-10
3. Should have read IA2/721/GS1-10

A. Dissected, bagged, and frozen individually.
B. Frozen whole - too small to dissect.

Summary of Data on Invertebrates & Other Samples Collected on the Second Leg of the Albatross IV 1971 Spring Groundfish

Invertebrates Species	Code	Lm. (Cm)	Cons. Tow no.	Location Lat.	Long.	Strata	Tow	Depth (F.)	Date	R
Shrimp										
Crangon sp.	IA2/CU2/SP1		127	40-06	73-43	1	2	19-19	31/III/71	
Pandalids	IA2/CU2/SP2		127	40-06	73-43	1	2	19-19	31/III/71	
Squid	IA2/GS2/UX1-10		165	37-16	74-30	68	2	140-190	5/IV/71	
Lobsters	IA2/S-4/HA1-10	6-10	188	39-21	72-15	4	2	177-178	9/IV/71	
		14-19	190	39-30	72-11	4	*	165-200	10/IV/71	
Sea Scallops	IA2/S57/SC1-10	5-8	145	37-13	74-50	65	7	32-32	2/IV/71	
Squid										
Loligo sp.	IA2/662/LL1-10		144	37-21	74-43	66	2	29-30	2/IV/71	
Illex sp.	IA2/642/IX1-10		161	36-19	74-48	64	2	110-125	4/IV/71	
Cotton Samples										
	IA2/733/BG		133	39-19	73-51	73	3	22	1/IV/71	
	IA2/653/Sed		149	36-51	75-26	65	3	10	3/IV/71	
	IA2/622/Sed		158	36-03	74-52	62	2	41	4/IV/71	
Plankton										
	IA2/733/PKT		133	39-19	73-51	75	3		1/IV/71	
	IA2/653/PKT		149	36-51	75-20	65	3		3/IV/71	
	IA2/622/PKT		158	36-03	74-52	62	2		4/IV/71	

A. Dissected, bagged, and frozen individually.
B. Frozen whole.
C. 24" Bongo, .333 mesh, variable time and depth.
* Unscheduled station.

Summary of Data for Fish Samples Collected on the Third Leg of the Albatross IV 1971 Spring Groundfish Survey

Species	Code No.[1]	Fork Ln. (cm)	cons. tow no.[1]	Location Lat.	Long.	Stratum	tow	Depth (F.)	Date	Pr
American dab	1A3/40-205/AD1-5	32-36	1	42-47.5	70-38	40	1	50-50	4/17/71	A
American dab	1A3/40-206/AD6-10	39-43	2	42-52.5	70-35	40	2	50-50	4/17/71	A
Cusk	1A3/27-209/CK1-3	32-78	4	43-14.3	69-58	27	4	70-65	4/18/71	A
Cusk	1A3/27-212/CK4-9[2]	44-68	1	42-48.3	70-07	27	1	70-58	4/18/71	A
White hake	1A3/28-213/WH1-10	57-68	7	42-43.7	69-40	28	7	150-150	4/18/71	A
Shanny	1A3/40-231/NY1-20[3]	8-12	4	43-44	69-07.5	40	4	50-52	4/21/71	B
Winter flounder	1A3/39-237/WR1-4	22-46	3	44-11	67-55.5	39	3	49-45	4/21/71	A
Winter flounder	1A3/39-239/WR5-10	36-48	4	44-16.5	67-44	39	4	49-46	4/22/71	A
Veiled sculpin	1A3/34-248/SS1-10	8-13	4	43-35	66-40.5	34	4	60-55	4/23/71	B
Pollock	1A3/31-257/PK1-10[4]	23-75	6	42-54.3	66-35.5	31	6	83-93	4/24/71	A
Pollock	1A3/31-258/PK11[4]	51	5	42-48.3	66-36.5	31	5	92-90	4/24/71	A
Spiny dogfish	1A3/29-259/DY1-10	68-78	8	42-42.5	67-04.5	29	8	125-145	4/24/71	A
Argentine	1A3/30-263/AT1-10	32-38	3	42-28.5	67-25.5	30	3	180-180	4/25/71	A
Thorny skate	1A3/32-269/TS1-10	60-93	7	42-40.5	66-11.5	32	7	35-36	4/25/71	A
Wolf fish	1A3/32-270/WF1-10	78-93	4	42-41.5	66-06.5	32	4	40-40	4/25/71	A
Spiny dogfish	1A3/31-309/DY11-20	68-75	10	42-20	65-35	31	10	60-60	4/29/71	A
Sand lance	1A3/31-309/SL1-10	23-30	10	42-20	65-35	31	10	60-60	4/29/71	B

1. Coding system is different from that used on first and second legs. Consecutive tow numbers were used in the code rather than the tow within stratum number.
2. Only 9 cusk were obtained.
3. Twenty shannies were frozen whole, because of small size.
4. PK10 was much smaller than PK1-9, so PK 11 was obtained from next tow. PK 11 was nearer in size to PK 1-9.

A. Dissected, bagged, and frozen individually.
B. Frozen whole - too small to dissect.

SUMMARY OF DATA ON INVERTEBRATES, PLANKTON AND BOTTOM SAMPLES

COLLECTED ON THE THIRD LEG OF THE ALBATROSS IV GROUND FISH SURVEY

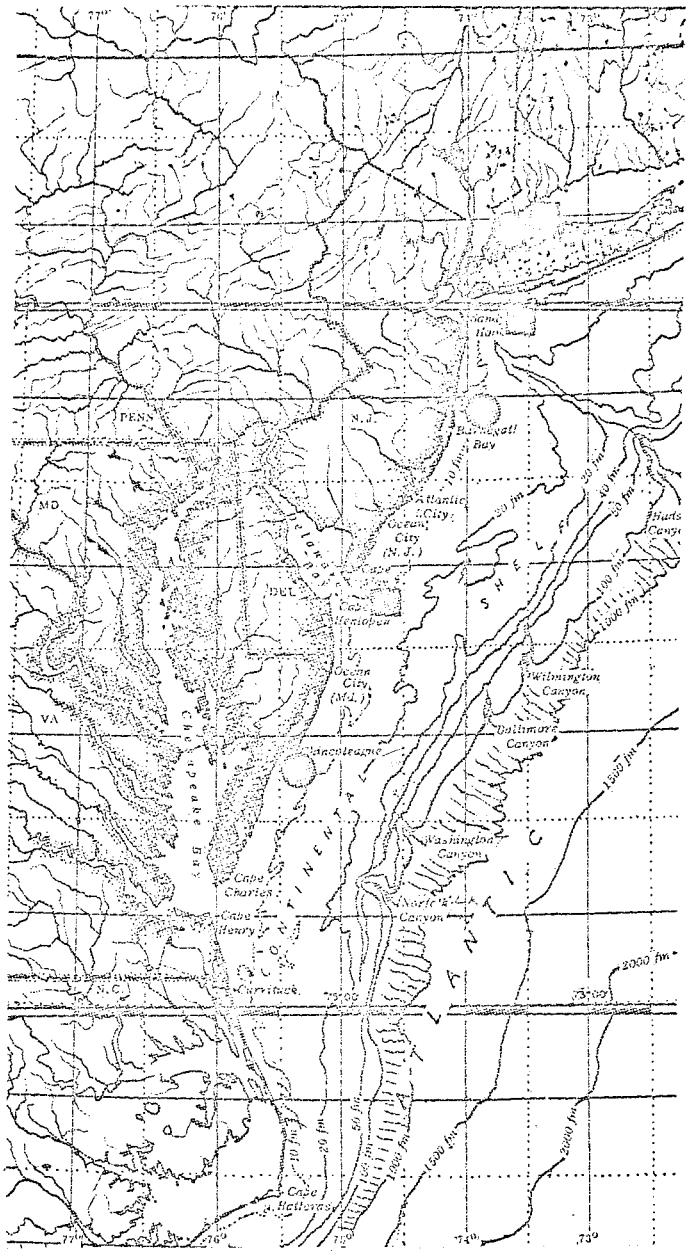
Species	Code number	Tow No.	Location			Depth	Date	Remarks
			Lat.	Long.	Stratum-tow			
1. Pandallis shrimp	1A3/40-205/PD1-10	1	42-47.5	70-38	40-1	50-50	4-17-71	B
2. Pandallis shrimp	1A3/24-217/PD11-20	6	42-03.5	68-43.7	24-6	88-95	4-19-71	B
3. Loligo squid	1A3/19-353/LL1-10	12	41-58.5	68-22.5	19-12	25-27	5-3-71	B
4. Plankton	1A3/38-232/plankton	4	43-32.5	68-44	38-4	80-75	4-21-71	
5. Sediment	1A3/38-232/sediment	4	43-32.5	68-44	38-4	80-75	4-21-71	
6. Plankton	1A3/47-285/plankton	5	42-49.7	64-31.5	47-5	55-55	4-27-71	
7. Sediment	1A3/47-285/sediment	5	42-49.7	64-31.5	47-5	55-55	4-27-71	

B Frozen whole, together

APPENDIX C

COOPERATIVE CONTAMINANT STUDY

DUMP SITE STATIONS



Waste disposal site

Uncontaminated control site

APPENDIX D

COOPERATIVE DUMP SITE STUDY

The purpose of this study is to critically examine the affects of ocean dumping on increasing contaminant levels in the environment and the potential limitations on abundance and distribution of living marine resources. Three dump sites and three control sites have been selected in the middle Atlantic bight. Sandy Hook Marine Laboratory will conduct all sample operations on the New York and Delaware dump sites and the Barnegat control site with cooperation from Oxford Biological Laboratory. Oxford will conduct all studies on the Chincoteague control site. Milford will select and develop operations for the Long Island Sound dump and control sites.

The study will initially examine 3 target species for contaminants and pathology--a fish, a crustacean, and a mollusk--species to be determined after the preliminary survey. In no way is the selection of target species intended to be limiting, and it is expected that each facility will conduct more ambitious studies relating to their specific interests.

At this time we are projecting 30 days of vessel time for this fiscal year. Ten days will be devoted to a general shakedown and survey cruise to define dump-site limits and benthic communities in the latter half of March, and the balance will be assigned to 3-day cruises in April, May, and June for actual sampling. These cruises will work the New York and Delaware dump sites and the Barnegat control site. Sandy Hook's R/V Dolphin will be the prime vessel for the mid-Atlantic bight surveys (20 days); Milford will probably use the R/V Shang Wheeler in the Long Island Sound area; and Oxford will use charter vessels on the Chincoteague site (10 days). A chartered surf clam vessel will be used on certain weekends for further bottom surveys.

Initially we are planning that the following samples will be obtained each month:

a) Ten (10) specimens for contaminant and pathology studies of each of 3 target species for each site. 10 x 3 x 6 = 180 specimens each month. At one dump site (Delaware) additional samples of animals and sediments will be obtained at the center, near the edge, and at a selected distance outside the dump site. Tissue sampling protocols are appended.

b) Any additional organisms showing gross pathology will be obtained for Oxford pathologists.

c) A bottom sample or samples will be obtained in each site for sediment analyses and faunal composition. The Smith-McIntyre or the Saunders anchor dredge could be used.

d) Special, separate, samples will be obtained of the target species for radionuclide assay. A minimum of 3 pounds of meat is necessary for each species from each site.

The analytical examination of samples will be delegated as follows:

a) Tissues of each specimen will be analyzed for mercury by staff of the Ann Arbor Technology Laboratory. Prime tissues will be muscle and liver to parallel results of other contaminant studies. However, it is expected that these and other organs will be preserved for future analyses of a much broader range of heavy metals (e.g., lead, arsenic, cadmium, chromium) up to as many as 12 ions. Similarly, these tissues obtained for (a) will also be analyzed by staff for pesticides later.

b) Sections of the same tissues obtained for (a) will be examined at Oxford for pathology and correlation with any concentrations of contaminants found in heavy metal analyses.

c) Sediments and water samples will be analyzed by Ann Arbor staff for mercury concentrations, and portions of these samples will be reserved for future broad analyses as proposed for tissues.

d) Sediment and water samples will also be prepared aboard ship and examined by Milford-Ann Arbor microbiologists for a base-line survey of microflora and for possible indicative modifications of species composition in contaminant areas.

e) Oxford laboratory will be responsible for microbiological studies of the organisms, particularly with emphasis on potential pathogenic bacteria on or within the organism.

f) The special radionuclide samples will be processed at the Center for Estuarine and Menhaden Research, Beaufort, N. C. Monthly samples may not be required for this work, and the sampling schedule will be based on preliminary analyses of early samples.

g) Much of the study will depend upon accurate taxonomic identifications. Technical assistance will be used as available within the cooperating facilities, and, in addition, the National Center for Systematics has volunteered to examine representative specimens from the entire collection.

h). The Milford laboratory will undertake controlled laboratory experiments on the physiological responses of known levels of contaminants on the life history stages of selected organisms. Milford will concentrate studies on mollusks and crustaceans initially, but will later expand their experiments to include finfish.

On occasion, gravid fish and invertebrates will be obtained from study sites, but more commonly they will be obtained as available from other areas. If obtained from other areas it will be essential to assay contaminant levels of the adults to understand the exposure history of these populations.

i) The Sandy Hook Marine Laboratory will have the responsibility for ecological studies on the New York and Delaware dump sites and the Barnegat control site. Other laboratories will use protocols established by the Sandy Hook laboratory. A detailed sampling program for the ecological surveys will be established by Sandy Hook in cooperation with Oxford and other laboratories involved.

APPENDIX E

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Sandy Hook Sport Fisheries Marine Laboratory
Highlands, New Jersey 07732

Date: April 16, 1971

Reply to Attn of: FF61

Subject: Marine Contaminants Program: cooperative studies between SHSFML; NMFS Laboratory Oxford, Md., and NMFS Laboratory Milford, Conn. for period March 29 - April 9, 1971

To:
Dr. Robert Hanks (FF314)
National Marine Fisheries Service
Oxford Biological Laboratory
Oxford, Maryland 21654

Enclosed is a brief memo report on the first two weeks of field study at the Delaware Bay waste disposal site. Similar reports will be prepared at the conclusion of each month's work and distributed to all offices concerned with these activities.

Lionel A. Walford

Lionel A. Walford
Laboratory Director

Encl.

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Laboratory Director

DATE: April 13, 1971

FROM : Jack B. Pearce, Project Leader

SUBJECT: Challenger and Dolphin Operations at the Delaware Bay Solid Waste Disposal Site

The R. V. Challenger departed from Sandy Hook at 0400 hrs, 29 III 71 and arrived at Cape May Coast Guard Station at 1830 hrs of the same day. We commenced our sampling operations on 30 III 71 taking Smith-McIntyre grab samples at 18 stations at and around the designated dump site and at several stations some distance removed from the site. Operations were slower than usual due to adverse weather and high seas. We were unable to reach the site of dumping activities on Wednesday, 31 III 71 because of extremely adverse weather. Water samples for nutrients and dissolved oxygen were taken at the Whistle Buoy (Station Wb) midway between Cape May Inlet and the dumping grounds.

Sandy Hook personnel aboard during these two days included A. Draxler, J. Pearce and J. Prescott. Oxford personnel included R. Hanks and J. Ropes.

The second research team headed by C. Gibson was unable to carry out normal operations on 1 and 2 IV 71 because of continued adverse weather and heavy seas. Similar conditions prevailed the following week and the period 5-7 IV 71 was used to make minor repairs to the Challenger and gear.

On Thursday, 8 IV 71, the weather had moderated sufficiently so that we could conduct trawling and dredging operations from the Challenger. We were able to obtain 5 species of bottom-dwelling finfish from the disposal area as well as at stations located at the entrance to Cape May Inlet and midway between Cape May and the waste disposal site. The R.V. Dolphin also took a series of trawls at the disposal area (8 IV 71) and at the Barnegat Bay control site (9 IV 71). The species of finfish taken and their abundance are given in Table I attached to this memo. They included the designated "target" species as well as other bottom-dwelling and pelagic species.

We were able to obtain sufficient Cancer irroratus at the Delaware disposal site and at stations between this site and Cape May. Data concerning this target species is given in the attached Table II. We were also able to collect a large enough amount of zooplankton from the disposal area to send to the NMFS Technology Laboratory at Ann Arbor.

We were unable to obtain sufficient surf clams for analyses. We will obtain these organisms on a future cruise. It might be auspicious if surf clams could be collected in the Delaware area by a local clam dredger. We can collect clams at the Barnegat Bay control and New York waste disposal sites using our heavy clam dredge but this device tends to break the valves of a large portion of the clams making them unusable for bacteriological and heavy metal analyses.

Parasol bottom drifters and bottle surface drifters were released at four stations in and around the Delaware disposal site. The Loran fixes and latitude and longitude for each point of release are given in Table III.

Finfish, shellfish, zooplankton and sediments have been sent to Dr. Harry Seagran, Laboratory Director, NMFS Technology Laboratory, Ann Arbor, for analyses for their mercury content and other heavy metals. The samples were labelled according to the procedures (protocol) established during an earlier meeting of concerned personnel. The one exception to these procedures is that the common name is given in its entirety. A complete listing of the materials furnished to the Ann Arbor laboratory is given in Table IV.

Based on field examinations and preliminary sorting and analyses of field collections, we now believe that the effects of the dumping in the Delaware disposal area are miniscule when compared with the effects of waste disposal in the New York Bight. Even at the designated center of dumping activities (Station D5) we could not find any significant diminution in the quality of the benthic communities (Fig. 1). The benthic macrofauna appeared to be as numerically abundant at the dump site as in surrounding areas. Only a small area was found to be characterized by black reducing sediments (Fig. 2) and in this case the reducing sediment formed a narrow strata between two layers of

clean sediments (Figs. 3 and 4). There was no evidence indicating an accumulation of a thick layer of "black mayonnaise" which is characteristic of the sewer sludge and dredge spoil disposal areas in the New York Bight. Based on our study in the New York Bight we recommend that sampling not be restricted to the spring and early summer; rather we should sample the disposal area during the summer when elevated temperatures and a greater possibility for reducing conditions and reduced dissolved oxygen prevail in the Delaware disposal area. There is also considerable evidence indicating that elevated temperatures result in increased pathologies in crustaceans. It is during the summer months when increased metabolic activities might result in an elevated rate of heavy metal uptake.

Examination of finfish and crabs collected during the period 30 III - 8 IV did not indicate any significant amount of pathological anomalies in organisms taken at or near the Delaware disposal area. Again, such anomalies may be more numerous during periods of elevated temperatures.

While the Delaware waste disposal site is apparently not impoverished to the same extent as the sites in the New York Bight, it is important to give further time to its study, if only as an example of a growing or potential problem site. It is not surprising that it is not as despoiled as only one forty-fifth the amount of waste is being disposed of there as in the New York Bight. Nevertheless, local shellfishermen and finfishermen testify that these dumping activities have affected standing crops and productivity.

Jack B. Pearce

Table I:--Collections of finfish made during *Challenger* cruise 1Ch1, 29 III - 8 IV 1971. Sampling transect or station, collecting gear and species taken are given for each collection.

Two collections were made by the R. V. *Dolphin* on 8 and 9 IV 1971. Samples from these collections were furnished to the Ann Arbor Laboratory but designated as collections made by the *Challenger*.

April 8, 1971; R. V. Challenger collections made at Delaware sludge disposal site; Finfish trawl #1; individuals marked with an * have been sent to Ann Arbor.

Winter flounder, *Pseudopleuronectes americanus*

total length in mm:

282 *	177 *	314 *	210 *

Blueback, *Alosa aestivalis*

307 *	206 *	195 *	180 *
209 *	207 *	168 *	

Windowpane flounder, *Scophthalmus aquosus*

271 *	276 *

Glufstream flounder, *Citharichthys arctifrons*

96

Whiting, *Merluccius bilinearis*

250	283

April 8, 1971; R. V. Challenger collections made at Delaware sludge disposal site; Finfish trawl #2.

Winter flounder, *Pseudopleuronectes americanus*

301 *	306 *	180 *	174 *
288 *	286 *	188 *	175 *
305 *	239 *	200 *	125 *

Windowpane flounder, *Scophthalmus aquosus*

261 *	165 *	242 *
252 *	295 *	

Yellowtail flounder, *Limanda ferruginea*

375 *	372 *	368 *	383 *

Sea herring, *Clupea harengus*

230

Whiting, *Merluccius bilinearis*

430	395	140

Longhorn sculpin, *Myoxocephalus octodecimspinosus*

280 *	259 *	291 *	291
259 *	268 *	285 *	281
256 *	285 *	269	285
261 *	268 *	294	

Each sculpin had at least one *Cancer irroratus* in its digestive tract.

April 8, 1971; R. V. Challenger collections made at Delaware sludge disposal site; Finfish trawl #3.

Yellowtail flounder, *Limanda ferruginea*

407 *	369 *	356 *	340 *

Windowpane flounder, *Scophthalmus aquosus*

244 *	260 *	239 *	238 *
245 *	256 *	224 *	

April 8, 1971; R. V. Challenger collections made at Delaware sludge disposal site; Shell dredge #3, whistle buoy (sta. Wb).

Windowpane flounder, *Scophthalmus aquosus*

268 *	245 *	237 *	260
275 *	262 *	233 *	247
228 *	245 *	230	
243 *	243 *	220	

Gulfstream flounder, *Citharichthys arctifrons*

97

April 8, 1971; R. V. Challenger collections made at Delaware sludge disposal site; Shell dredge #4, buoy 2CM (sta. 2CM).

Windowpane flounder, *Scophthalmus aquosus*

250 *	243 *	240 *	261 *
253 *	252 *	240 *	212
270 *	237 *	297 *	

April 8, 1971; R. V. Dolphin collections made at Delaware sludge disposal site (Dolphin sta. CM-1, Cruise D-71-3); Individuals marked * sent to Ann Arbor; liver and filets.

Windowpane flounder, *Scophthalmus aquosus*

264 *	230 *	269 *	232 *
243 *	251 *	282 *	253 *
209 *	248 *	271 *	237 *
227 *	273 *	232 *	233 *
283 *	216 *	261 *	254 *

Winter flounder, *Pseudopleuronectes americanus*

total length in mm:	digestive tract contents
242 *	1 caprellid, nereids, hydroids, 2 *Crangon*
275 *	4 nereids
226 *	6 nereids, hair (bottled)
231 *	hydroids, one gammarid, *Pontogeneia inermis*
214 *	5 nereids
222 *	empty
231 *	6 Onuphidae, hair

April 9, 1971; R. V. Dolphin collections made at Barnegat Bay control site (Dolphin sta. BO-1, Cruise D-71-3). Individuals marked * sent to Ann Arbor.

Windowpane flounder, *Scophthalmus aquosus*

278 *	276 *	285 *	281 *
254 *	296 *	298 *	
294 *	310 *	297 *	

Yellowtail flounder, *Limanda ferruginea*

303 *	371 *	355 *	307 *
294 *	362 *	338 *	321 *
389 *	324 *	345 *	

Sea herring, *Clupea harengus*

347 *	207 *	320 *	289 *
271 *	257 *	298 *	

Table II:--Collections of the crab *Cancer irroratus* made during *Challenger* cruise 1Ch1, 29 III - 8 IV 1971. Data include carapace width, sex, condition (reproductive and moulting) and final disposition for each individual crab collected.

April 8, 1971; Station D5; Loran Fix 3H5-3151 x 3H4-3424; Delaware sludge disposal grounds. Individuals marked with an * have been sent to Ann Arbor Labs for heavy metal analyses.

Rock crab, Cancer irroratus:

Carapace wd., mm	Sex	Condition	Disposition
100.0 *	F	Ov, dirty	Sent to Ann Arbor for metal analyses
110.0 *	M	Paper	" " " " " " "
80.7 *	M	"	" " " " " " "
88.6 *	M	"	" " " " " " "
108.7 *	M	"	" " " " " " "
88.0 *	M	"	" " " " " " "
93.7 *	M	"	" " " " " " "
126.3 *	M	"	" " " " " " "
84.8 *	F	Ov, dirty	" " " " " " "
90.8 *	M	Paper	" " " " " " "
95.0 *	M	"	" " " " " " "
70.4 *	M	"	" " " " " " "
94.4 *	F	Ov, hard	" " " " " " "
95.2 *	M	Hard	" " " " " " "
81.5 *	F	Ov, hard	" " " " " " "
98.2 *	M	Paper	" " " " " " "

April 8, 1971; Station Whistle Buoy; Loran Fix 3H5-3169 x 3H4-3454; 5.5 nautical miles north of Delaware sludge disposal grounds.

88.9 *	F	Not ov, hard	Sent to Ann Arbor in single bay
88.1 *	F	Ov, dirty	" " " " " " "
90.7 *	F	" "	" " " " " " "
90.1 *	F	" "	" " " " " " "
80.6 *	F	" "	" " " " " " "
77.0 *	F	" "	" " " " " " "
76.6 *	F	" "	" " " " " " "
77.0 *	F	" "	" " " " " " "

April 8, 1971; Fish trawl #2; Loran Fix 3H5-3153 x 3H4-3454 to 3H5-3157 x 3H4-3154; three nautical miles north of Delaware sludge disposal grounds.

122.0	M	Paper	measured, sexed, examined for pathological anomalies
82.8	M	"	" " " "
69.2	M	"	" " " "
62.7	M	"	" " " "
57.4	M	Hard	" " " "

64.6	M	Paper	"	"	"	"
66.4	M	Hard	"	"	"	"
50.0	M	Hard, necrotic	"	"	"	"
48.8	M	Paper	"	"	"	"
55.3	F	Non-ov, paper	"	"	"	"
43.7	M	Hard	"	"	"	"
48.0	M	"	"	"	"	"
42.2	M	Paper	"	"	"	"
52.2	M	"	"	"	"	"
35.7	F	Non-ov, paper	"	"	"	"
38.3	M	Hard	"	"	"	"
35.2	M	"	"	"	"	"
35.3	M	"	"	"	"	"
31.0	M	"	"	"	"	"
31.0	M	"	"	"	"	"
33.0	M	"	"	"	"	"
34.2	M	Paper	"	"	"	"
31.7	M	Hard	"	"	"	"
32.4	M	"	"	"	"	"
43.4	F	Ov, hard	"	"	"	"
22.9	F	" "	"	"	"	"
40.2	F	" "	"	"	"	"
27.9	F	" "	"	"	"	"
32.2	F	" "	"	"	"	"
26.2	F	" "	"	"	"	"

April 8, 1971; Fish trawl #1; Loran fix 3H5-3169 x 3H4-3454 to 3H5-3165 x 3H4-3450; from Whistle Buoy towards sludge disposal grounds.

86.2	M	Paper	"	"	"	"
65.7	F	Ov, hard	"	"	"	"

April 8, 1971; Shell dredge #4; Buoy 2CM; Loran fix 3H5-3184 x 3H4-3500; near Cape May Inlet.

120.0	M		Measured and taken by Marty Neuman for analyses at Oxford					
100.0	M		"	"	"	"	"	"
110.0	M		"	"	"	"	"	"
100.0	M		"	"	"	"	"	"
90.0	M		"	"	"	"	"	"
100.0	M		"	"	"	"	"	"
110.0	M		"	"	"	"	"	"
120.0	M		"	"	"	"	"	"
120.0	M		"	"	"	"	"	"
80.0	F		"	"	"	"	"	"
90.4	M	Paper	Measured, sexed, examined for pathological anomalies					
90.2	M	"	"	"	"	"		

84.6	M	"	"	"	"	"
101.1	M	"	"	"	"	"
70.7	M	Paper, necrotic	"	"	"	"
70.3	M	Paper	"	"	"	"
83.1	M	"	"	"	"	"
95.3	M	"	"	"	"	"
77.7	M	"	"	"	"	"
63.9	M	Hard	"	"	"	"
74.8	M	Paper	"	"	"	"
83.4	M	"	"	"	"	"
69.7	M	Paper, necrotic	"	"	"	"
59.2	M	Paper	"	"	"	"
71.5	M	"	"	"	"	"
68.2	M	"	"	"	"	"
68.8	M	"	"	"	"	"
67.7	M	"	"	"	"	"
61.0	M	Hard	"	"	"	"
63.1	M	Paper	"	"	"	"
54.1	F	Hard	"	"	"	"
71.7	M	Paper, necrotic	"	"	"	"
65.3	M	Paper	"	"	"	"
61.1	M	Hard	"	"	"	"
62.3	M	Paper	"	"	"	"
64.8	M	"	"	"	"	"
68.6	M	"	"	"	"	"
58.7	M	Hard	"	"	"	"
65.1	M	Paper	"	"	"	"
76.8	M	"	"	"	"	"
83.0	M	"	"	"	"	"
65.7	F	Hard	"	"	"	"
74.7	M	Paper, necrotic	"	"	"	"
68.2	M	Hard, necrotic	"	"	"	"
85.1	M	Paper	"	"	"	"
88.8	M	"	"	"	"	"
78.9	M	"	"	"	"	"
84.6	M	"	"	"	"	"
72.5	M	"	"	"	"	"
115.3	M	"	"	"	"	"
49.4	M	"	"	"	"	"
67.4	M	"	"	"	"	"
91.6	M	"	"	"	"	"
66.3	M	"	"	"	"	"
99.5	M	"	"	"	"	"
74.1	M	"	"	"	"	"
72.9	M	"	"	"	"	"
110.7	M	"	"	"	"	"
100.9	M	Hard	"	"	"	"
121.3	M	Paper	"	"	"	"
76.9	M	"	"	"	"	"
79.9	M	"	"	"	"	"
67.0	M	"	"	"	"	"

69.8	M	"	"	"	"	"
62.7	M	"	"	"	"	"
58.6	M	"	"	"	"	"
73.3	M	"	"	"	"	"
62.2	M	"	"	"	"	"
69.8	M	Paper, necrotic	"	"	"	"
58.5	M	Paper	"	"	"	"
59.9	M	"	"	"	"	"
60.3	M	"	"	"	"	"
67.0	M	"	"	"	"	"
73.2	F	Hard	"	"	"	"
57.8	M	Paper	"	"	"	"
79.4	M	"	"	"	"	"
66.8	M	"	"	"	"	"
59.8	M	Paper, necrotic	"	"	"	"
61.3	M	Paper	"	"	"	"
76.9	M	"	"	"	"	"
52.0	M	"	"	"	"	"
61.0	M	Paper, necrotic	"	"	"	"

Table III:--Serial numbers, station numbers and position of station for surface and bottom drifters released on 8 IV 1971.

Surface and bottom drifters released at approximately 1330 hr., April 8, 1971 in general area of sewer sludge dumping grounds at mouth of Delaware Bay.

CURRENT DRIFTERS		POSITION OF RELEASE		
Bottom Serial Numbers	Surface Serial Numbers	Station Number	Loran Fix	Latitude and Longitude
059901-059930	9001-9034	C4	3H5-3153 x 3H4-3422	38°45.8'N x 74°48'W
059931-059960	9035-9068	G5	3H5-3146 x 3H4-3417	38°44.4'N x 74°46.2'W
059961-059990	9068-9104	Whistle Buoy	3H5-3169 x 3H4-3454	38°50.6'N x 74°50.2'W
059991-060000	---	Buoy 2CM	3H5-3183.5 x 3H4-3500	38°55.8'N x 74°51.3'W

Table IV:--Listing of materials sent to NMFS Technology Laboratory on 12 April 1971. Sediment cores are listed by station (see Fig. 5). Finfish and invertebrate materials are listed by station, species and tissue type. Station D5 is located at the designated center of dumping activities, station Wb is at the Whistle buoy midway between the dumping site and Cape May Inlet and station 2CM is located at the entrance to Cape May Inlet. These stations provide a possible gradient of distribution along a transect from shore to the dumping area. Station BB is the control site located off Barnegat Bay.

April 12, 1971 - following materials sent to Dr. Harry Seagran, National Marine Fisheries Service Technology Laboratory, Ann Arbor, Michigan.

Following code system applicable to all samples taken during period March 30-April 8, 1971 by R. V. Challenger and R. V. Dolphin:

Cruise No. (1971 Challenger-1)

1Ch1/69-D5/yellowtail flounder-liver

NMFS Strata Station Common Name Tissue

Sediment cores:

1Ch1/69 - A5/sediment	1Ch1/69 - D6/sediment
B5/sediment	E5/sediment
B6/sediment	E6/sediment
C5/sediment	F5/sediment
C6/sediment	F6/sediment
D5/sediment	G5/sediment
D5a/sediment	G6/sediment
D5b/sediment	2CM/sediment

Finfish tissues:

1Ch1/69-Wb/winter flounder-liver
" " " -muscle
D5/ " " -liver
" " " -muscle
1Ch1/69-2CM/windowpane flounder-liver
" " " -muscle
Wb/ " " -liver
" " " -muscle
D5/ " " -liver
" " " -muscle
1Ch1/73-BB/ " " -liver
" " " -muscle
1Ch1/69-D5/yellowtail flounder-liver
" " " -muscle
1Ch1/73-BB/ " " -liver
" " " -muscle
1Ch1/69-D5/longhorn sculpin-liver
" " " -muscle
1Ch1/69-D5/ocean pout-liver
" " " -muscle
1Ch1/69-D5/whiting-liver
" " -muscle

1Ch1/69-D5/sea herring-liver
" " " -muscle
1Ch1/73-BB/ " " -liver
" " " -muscle

Invertebrate and zooplankton materials:
1Ch1/69-2CM/cancer-gill
" -liver
" -muscle
Wb/ " -egg
" -gill
" -liver
" -muscle
D5/ " -egg
" -gill
" -liver
" -muscle
1Ch1/69-Wb/plankton (mixed)
D5/ " "

Fig. 1:--View of fauna collected in Smith-McIntyre Quantitative Bottom Grab at the Delaware waste disposal site. Note the *Cancer irroratus* and *Nassarius* sp. in the upper left corner of the grab sample. These species were common to the coarse sands found throughout the designated waste disposal area.

Fig. 2:--A view of the sediment collected in the Smith-McIntyre Grab at station D5. Although appearing to be slightly reduced this sediment had no obvious sludge odor and had associated with it a fauna considered normal for the sediment grain size distribution.

Fig. 3:--A section of the grab sample shown in Fig. 2. Note that a layer of slightly reduced sediment occurred between two clean strata. This suggests that deposits of sludge or other wastes are covered with clean sands. This probably occurs during storms and intensive wave action. Accumulation of sludge might occur during periods of calm weather and increased temperature.

Fig. 4:--A standard geological core removed from the grab sample shown in Fig. 2. Note the clean interface between the reducing sands at the bottom end of the core and the overlying clean sands.

APPENDIX F

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

Inter-Office

TO : Laboratory Director

DATE: May 5, 1971

FROM : Jack B. Pearce, Project Leader

SUBJECT: R. V. Dolphin Operations at the New York Bight and Delaware Bay Solid Waste Disposal Sites and the Barnegat Bay Control Site, 20-21 April 1971

The R. V. Dolphin departed from Sandy Hook at 0930 hrs, 20 IV 71 and commenced operations at New York Bight station 1956 where bottle surface and parasol bottom drifters were released in New York Bight, off Barnegat Bay and at the Delaware Bay waste disposal area (Table III).

Water quality measurements were made at stations 59, BB and D5 (Table IV).

The Dolphin made otter trawl hauls at stations 70, BB and D5. The finfish collected at these stations are listed in Table I attached to this memo. Shellfish collected in either otter trawl hauls or clam rakes are listed in Table II.

Zooplankton collections were made at stations 59, BB and D5. The collections were frozen in toto and have been sent to the NMFS Technology Laboratory, Ann Arbor.

Once again we were unable to obtain sufficient clams for heavy metal analyses with our shell dredge. Fortunately, at the Delaware Bay site a cooperative effort by a commercial clam dredger provided us with two dozen clams which we have furnished to the Technology Laboratory for analysis for heavy metals. We will make the arrangements necessary to obtain clams representative of the New York Bight site from a commercial dredger.

Sediment cores were taken at station BB and several stations at the Delaware waste disposal site (Table V). These cores have been sent to the Technology Laboratory, Ann Arbor, for analyses. A series of cores will be taken during our next Dolphin cruise to the New York Bight sewer sludge and dredge spoil disposal areas.

Filets of muscle tissue and liver tissue were removed from finfishes and were sent to Ann Arbor. Tissues from each individual fish were kept separate and labelled in the manner described in the report for Challenger cruise 1Ch1. Individual fish of each species are designated on the labels by the total length of the fish in mm.

Gill, liver and muscle (abdomen) tissues were removed from crabs and lobsters. In the case of the crabs, Cancer irroratus, tissues removed from several crabs at each station were combined, i.e., each station is represented by gill, liver and muscle tissues.

Tissues from individual lobsters were not combined and represent each individual lobster processed (see Table II).

Recent analyses of sediments collected at stations in the New York Bight (Table VI) indicate the very high levels of heavy metals which have accumulated in the sediments of the Bight. The metals are concentrated at the center of the sewer sludges (Station 59) and dredge spoil (Station 82) disposal areas and diminish as the distance from the centers increases. Station G2 has very high values and we have recently observed reductions in species diversity and standing crops at this station.

Table VII is a copy of a report recently prepared at the EPA Water Quality Laboratory, Edison, N. J. The results of their recent bacteriological survey of the Delaware Bay site indicates low levels of contamination by coliform bacteria. They did not, however, sample sediments and it is our experience that although overlying waters may appear uncontaminated, sediments may have significant or very high populations of coliform bacteria. Therefore on at least one future cruise we should attempt to sample for a variety of microorganisms in the sediments at the Delaware Bay waste disposal site.

Jack B. Pearce

Table I:--Collections of finfish made during R. V. *Dolphin* cruise 1Dol, 20-21 IV 1971. Sampling station, collecting gear and species taken are given for each collection.

April 20, 1971; R. V. Dolphin collections of finfish made at New York Bight sewer sludge disposal site, station 70; Finfish trawl #1; individuals marked with an * have been sent to the NMFS Technology Laboratory, Ann Arobr, Michigan.

Winter flounder, Pseudopleuronectes americanus

total length in mm:

207 *	282 *	302 *	353 *

Windowpane flounder, Scophthalmus aquosus

235 *	253 *	219 *	214 *
231 *	201 *	237 *	
238 *	279 *	217 *	

Yellowtail flounder, Limanda ferruginea

310 *	325 *	307 *	319 *
302 *	305 *	291 *	306 *
315 *	310 *	315 *	325 *

April 20, 1971; R. V. Dolphin collections of finfish made at Barnegat Bay control station, station BB; Finfish trawl #1.

Winter flounder, Pseudopleuronectes americanus

257 *	383 *	198 *	229 *
206 *	211 *	174 *	356 *

Windowpane flounder, Scophthalmus aquosus

(following fish also dissected to obtain tissues for pathological analyses)

275 *	255 *	279 *	244 *
274 *	275 *	246 *	
282 *	285 *	263 *	

(following fish not dissected for pathological analyses; marked extra)

276 *	232 *	270 *	299 *
295 *	220 *	290 *	253 *
206 *	291 *	250 *	

Yellowtail flounder, Limanda ferruginea

(following fish also dissected to obtain tissues for pathological analyses)

343 *	305 *	336 *	342 *
325 *	327 *	325 *	311 *
319 *	340 *	315 *	334 *

(following fish not dissected for pathological analyses; marked extra)

345 *	346 *	325 *	365 *
327 *	271 *	362 *	

April 21, 1971; R. V. Dolphin collections of finfish made at Delaware sludge disposal site, station D5; Finfish trawl #1.

Winter flounder, *Pseudopleuronectes americanus*

285 *	175 *	231 *	378 *
295 *	321 *	289 *	
230 *	222 *	303 *	

Windowpane flounder, *Scophthalmus aquosus*

253 *	235 *	238 *	257 *
260 *	224 *	242 *	
246 *	275 *	239 *	

Yellowtail flounder, *Limanda ferruginea*

283 *	378 *	349 *	302 *

Table II:--Collections of the crab, *Cancer irroratus*, lobster, *Homarus americanus*, and surf clam, *Spisula* made during Dolphin cruise 1Do1, 20-21 IV 1971. Data include carapace width for crabs, thorax length for lobsters and depth of shell for clams as well as notes on sex, reproductive and moulting condition and final disposition for each individual animal.

April 20, 1971; Station 70; Loran fix1H5-3200 x 1H4-3635; Eastern border of N. Y. sewer sludge disposal grounds. Individuals marked with an * have been sent to Ann Arbor Tech. Laboratory for heavy metal analyses.

Rock crab, Cancer irroratus:

Carapace wd., mm	Sex	Condition	Disposition
117.5 *	M	Paper	Gill, liver and muscle separated from each crab and combined to form single samples of gill, liver and muscle tissue
102.1 *	M	Paper	" " " " " "
102.6 *	M	Hard	" " " " " "
103.9 *	M	Hard	" " " " " "
80.0 *	M	Paper	" " " " " "
101.4 *	M	Hard	" " " " " "
71.6 *	M	Paper	" " " " " "

April 20, 1971; Station 82; Loran fix1H5-3265 x 1H4-4590 ; Center of N. Y. dredge spoil disposal grounds.

120.9 *	M	Paper	" " " " " "
120.2 *	M	"	" " " " " "
103.3 *	M	"	" " " " " "
107.4 *	M	"	" " " " " "
108.0 *	M	"	" " " " " "
106.9 *	M	"	" " " " " "
104.2 *	M	"	" " " " " "
93.0 *	M	"	" " " " " "
96.4 *	M	"	" " " " " "
91.5 *	M	"	" " " " " "
99.6 *	M	"	" " " " " "
99.5 *	M	"	" " " " " "
98.7 *	M	"	" " " " " "
88.8 *	M	"	" " " " " "
80.6 *	M	"	" " " " " "
93.4 *	M	"	" " " " " "
90.2 *	M	"	" " " " " "
91.9 *	M	"	" " " " " "
97.7 *	M	"	" " " " " "
57.6 *	M	"	" " " " " "
75.4	M	"	" " " " " "
77.7	M	"	" " " " " "
76.7	M	"	" " " " " "
81.3	M	"	" " " " " "
74.4	M	"	" " " " " "
33.1	M	"	" " " " " "
29.3	M	Hard	" " " " " "
28.3	M	"	" " " " " "

Cancer borealis:

27.1	M		"	"	"	"	"	"
35.5	M		"	"	"	"	"	"
87.4	F	Non-ovigerous, dirty shell	"	"	"	"	"	"

Lobster, Homarus americanus

Thorax length, mm	Sex	Disposition
30.0 *		Gill, liver and muscle separated from each crab and sent as individual packets of tissue from individual lobsters
31.0 *		" " " " " "
30.0 *		" " " " " "
27.0 *		" " " " " "
25.2 *		" " " " " "
22.7 *		" " " " " "
20.0 *		" " " " " "
20.0		
20.5		
20.7		
19.3		
20.4		

April 20, 1971; Station BB; Loran fix 3H5-3196 x 3H4-4260; Control station off Barnegat Bay.

Rock crab, Cancer irroratus:

Carapace wd., mm	Sex	Condition	Disposition
117.9 *	M	Paper, non-ovigerous	
89.9 *	F	Hard, ovigerous	
69.6 *	F	Hard, "	
51.0 *	F	Paper, "	
46.0 *	F	Paper, "	
45.0 *	F	Hard, "	
56.2 *	F	Paper, "	
43.2 *	F	Paper, "	

April 21, 1971; Station D-5; Loran fix 3H5-3151 x 3H4-3424, Center of Delaware Bay sludge disposal grounds.

121.4 *	M	Hard	(Shell dredge)
116.2 *	M	"	
174.3 *	F	" , ovigerous	
87.6 *	F	" "	
76.9 *	F	" "	
85.1 *	F	" "	
81.3 *	F	" "	
85.5 *	F	" "	
112.8 *	M	Paper	(Fish trawl #2)
109.2	M	Hard	
126.9	M	Paper	
91.2	F	Hard, ovigerous	
105.1	M	Paper	
99.1	M	Hard	
95.3	M	Paper	
117.4	M	Paper	
99.6	M	Paper	
102.8	M	Paper	
113.3	M	Paper	
77.3	F	Hard, ovigerous	
70.8	M	Paper	
83.8	F	Hard, ovigerous	
44.0	M	Paper	
120.0	M	Hard	
98.0	M	Paper	
78.1	F	Hard, ovigerous	
77.7	F	Hard	
80.2	F	Hard, ovigerous	

Surf clam, Spisula

Umbo-ventral margin, mm	Disposition
111.0	Packet "A"
95.9	
119.7	
106.3	
118.3	
120.7	
105.2	
117.4	
112.7	
111.8	
113.0	Packet "B"
108.2	
123.6	
118.8	

117.4
119.6
119.9
125.4
110.3
112.7

Table III:--Serial numbers, station numbers and date, hour and position of surface and bottom drifters released on 20-21 IV 1971.

CURRENT DRIFTERS			DATE AND HOUR OF RELEASE	POSITION OF RELEASE	
Bottom Serial Numbers	Surface Serial Numbers	Station Number	Date and Hour	Loran fix	Latitude and Longitude
059511-059520	9105-9114	1956	20 IV 71, 0910	In Bay-Not Available	40°29'06"N x 73°58'12"W
059521-059530	9115-9124	107	20 IV 71, 0940	1H5-3265 x 1H4-4632	40°32'30"N x 73°53'55"W
059501-059510	9125-9134	61	20 IV 71, 1035	1H5-3215 x 1H4-4653	40°29'02"N x 73°47'03"W
059531-059540	9135-9144	70	20 IV 71, 1130	1H5-3200 x 1H4-3635	40°25'06"N x 73°44'54"W
059541-059560	9145-9164	59	20 IV 71, 1430	1H5-3222 x 1H4-4619	40°24'55"N x 73°47'24"W
059561-059570	9165-9174	82	20 IV 71, 1625	1H5-3265 x 1H4-4590	40°24'45"N x 73°52'15"W
059571-059590	9175-9194	BB	20 IV 71, 1906	3H5-3196 x 3H4-4260	39°50' N x 74°00' W
059591-059600	9195-9204	Whistle Buoy BW"FA"	21 IV 71, 0353	3H5-3148 x 3H4-3453	38°47'15"N x 74°44'15"W
059601-059620	9205-9224	D5	21 IV 71, 0420	3H5-3151 x 3H4-3424	38°45'48"N x 74°47'06"W
059621-059630	9225-9234	G1	21 IV 71, 0450	3H5-3148 x 3H4-3396	38°43'20"N x 74°48'48"W
059631-059640	9235-9244	Whistle Buoy BW"FB"	21 IV 71, 0515	3H5-3173 x 3H4-3399	38°47'18"N x 74°55'35"W
059641-059650	9244-9255	Whistle Buoy FLR	21 IV 71, 0545	3H5-3169 x 3H4-3455	38°50'33"N x 74°50'18"W

Table IV:--Temperature, salinity and dissolved oxygen measured at station 59, BB and D5

Station 59 (New York Bight sewer sludge disposal site):

	Surface	Bottom
Salinity	29.54	31.34
Temperature	6.74	5.17
Dissolved Oxygen	10.6	10.0

Station BB (Barnegat Bay control site):

Salinity	30.34	32.00
Temperature	6.22	5.20
Dissolved Oxygen	9.9	9.3

Station D5 (Delaware Bay waste disposal site):

Salinity	31.23	31.22
Temperature	7.23	7.20
Dissolved Oxygen	9.5	8.7

CRUISE / STRATA — STATION / TYPE SAMPLE

1Do1/73 — BB_1/sediment
1Do1/73 — BB_2/ "
1Do1/73 — BB_3/ "
1Do1/73 — BB_4/ "

1Do1/69 — A4 / "
1Do1/69 — B2 / "
1Do1/69 — B3 / "
1Do1/69 — B4 / "
1Do1/69 — C2 / "
1Do1/69 — C3 / "
1Do1/69 — C4 / "
1Do1/69 — D2 / "
1Do1/69 — D3 / "
1Do1/69 — D4 / "
1Do1/69 — E3 / "
1Do1/69 — E4 / "
1Do1/69 — F3 / "
1Do1/69 — F4 / "
1Do1/69 — G3 / "
1Do1/69 — G4 / "

Table V:--Sediment cores taken during R. V. Dolphin cruise

1Do1, 20-21 IV 1971.

Table VI:--Values for the heavy metals copper, lead and zinc at stations in the New York Bight; collected on 12 III 1971.

Heavy Metal Analyses of Sediments Collected

in the New York Bight, 12 III 71.

Station	Cu	Pb	Zn
36 (1)	8	0	12
(2)	8	0	15
64 (1)	12	30	30
(2)	16	0	24
82 (1)	160	110	102
(2)	620	390	134
39 (1)	80	30	84
(2)	112	70	96
59 (1)	368	350	94
(2)	160	170	94
(3)	88	100	85
total sample	188	180	100
4 (1)	120	100	119
(2)	84	80	109
70 (1)	60	100	65
(2)	88	50	58
(3)	32	30	44

Location	Cu	Pb	Zn
B-2 (1)	204	150	198
(2)	204	160	212
(3)	80	120	127
G-2 (1)	208	210	108
(2)	132	290	110
(3)	296	270	111
total	204	250	114

Note: (1) Results in ppm — Dry sediment

(2) Vertical strata sampled at following depths of frozen sample:
(1) 1-1.5 inches
(2) 1.5-3.0 inches
(3) Below 3.0 inches

TABLE VII

ENVIRONMENTAL PROTECTION AGENCY

Date: April 28, 1971

Reply to Chief, Microbiology Section
Attn. of:

Subject: Bacteriological Data obtained on water samples collected in the area of the Delaware Bay Solid Waste Disposal Site

To: Laboratory Director

The "Clean Waters" collected shallow and deep samples at 40 stations in the area of the Delaware Bay solid waste disposal site. Samples were collected on Tuesday, April 20, 1971 and on Wednesday, April 21, 1971. Due to adverse weather and relatively high seas, collection of samples at 8 of the 40 stations were suspended on Wednesday, April 21, 1971.

Based on the bacteriological data which follows in Table I, there is no indication of coliform contamination of the waters in the area of the disposal site. It is suggested that although the coliform counts were not significant at this time, that periodic sampling of the area be continued. The summer months should be included because at this time when elevated temperatures prevail, the potential exists for increased coliform populations.

Table I

	April 20, 1971		April 21, 1971	
Station Number	Total Coliform per 100 ml	Fecal Coliform per 100 ml	Total Coliform per 100 ml	Fecal Coliform per 100 ml
1-S	<2	<2	2	<2
1-D	2	2	2	<2
2-S	<2	<2	<2	<2
2-D	<2	<2	2	2
3-S	<2	<2	<2	<2
3-D	<2	<2	<2	<2
4-S	<2	<2	<2	<2
4-D	<2	<2	<2	<2
5-S	<2	<2	<2	<2
5-D	<2	<2	<2	<2
6-S	<2	<2	<2	<2
6-D	<2	<2	<2	<2
7-S	<2	<2	2	<2
7-D	<2	<2	2	<2
8-S	<2	<2	2	<2
8-D	<2	<2	2	<2

Station Number	April 20, 1971 Total Coliform per 100 ml	April 20, 1971 Fecal Coliform per 100 ml	April 21, 1971 Total Coliform per 100 ml	April 21, 1971 Fecal Coliform per 100 ml
9-S	<2	<2	<2	<2
9-D	2	2	5	2
10-S	<2	<2	2	2
10-D	<2	<2	2	<2
11-S	<2	<2	2	2
11-D	2	2	5	2
12-S	<2	<2	<2	<2
12-D	<2	<2	2	<2
13-S	<2	<2	<2	<2
13-D	5	<2	<2	<2
14-S	<2	<2	<2	<2
14-D	<2	<2	<2	<2
15-S	<2	<2	<2	<2
15-D	<2	<2	<2	<2
16-S	<2	<2	<2	<2
16-D	<2	<2	<2	<2
17-S	<2	<2	<2	<2
17-D	<2	<2	<2	<2
18-S	<2	<2	<2	<2
18-D	<2	<2	<2	<2
19-S	<2	<2	<2	<2
19-D	<2	<2	<2	<2
20-S	<2	<2	<2	<2
20-D	<2	<2	<2	<2
21-S	<2	<2	<2	<2
21-D	<2	<2	<2	<2
22-S	<2	<2	<2	<2
22-D	<2	<2	<2	<2
23-S	<2	<2	<2	<2
23-D	<2	<2	<2	<2
24-S	<2	<2	<2	<2
24-D	<2	<2	<2	<2
25-S	<2	<2	<2	<2
25-D	<2	<2	<2	<2
26-S	<2	<2	<2	<2
26-D	<2	<2	<2	<2
27-S	<2	<2	<2	<2
27-D	<2	<2	<2	<2
28-S	<2	<2	<2	<2
28-D	<2	<2	2	<2
29-S	<2	<2	<2	<2
29-D	2	<2	<2	<2
30-S	<2	<2	<2	<2
30-D	2	2	<2	<2

Station Number	April 20, 1971 Total Coliform per 100 ml	April 20, 1971 Fecal Coliform per 100 ml	April 21, 1971 Total Coliform per 100 ml	April 21, 1971 Fecal Coliform per 100 ml
31-S	<2	<2	<2	<2
31-D	<2	<2	<2	<2
32-S	<2	<2	<2	<2
32-D	5	2	<2	<2
33-S	<2	<2		
33-D	<2	<2		
34-S	<2	<2		
34-D	2	2		
35-S	5	<2		
35-D	5	2		
36-S	<2	<2		
36-D	<2	<2		
37-S	<2	<2		
37-D	<2	<2		
38-S	<2	<2		
38-D	<2	<2		
39-S	<2	<2		
39-D	2	<2		
40-S	<2	<2		
40-D	<2	<2		

I. Seidenberg

I. Seidenberg

APPENDIX G

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Sandy Hook Sport Fisheries Marine Laborator
Highlands, New Jersey 07732

Date: June 4, 1971

Reply to Attn of: FF61

Subject: R. V. Dolphin Operations at the New York Bight and Delaware Bay Solid Waste Disposal Sites and the Barnegat Control Site, 25-27 May 1971

To: Cooperating Investigators, Marine Contaminant Investigation
Dr. James E. Hanks
Dr. Robert Hanks
Dr. Harry L. Seagran

The R. V. Dolphin departed from Sandy Hook at 1000 hrs, 25 V 71 and commenced operations at New York Bight stations 36, 64, 82, 39, B2, 59, 70, and G2 where bottle surface and parasol bottom drifters were released. No bottles or drifters were released at station 39. Bottles and drifters were also released off Barnegat Bay, station BB, and at stations WBFA, WBFB, FLR and D5 in the Delaware waste disposal area.

Water quality measurements were made at stations 82, 59, BB, and D5. The Dolphin made otter trawl hauls at stations 70, BB, and D5. The finfish collected at these stations are listed in Table I attached to this memo. Shellfish collected in otter trawl hauls are listed in Table II. The irregular nature of the bottom at station 82 precluded taking samples at this station.

Zooplankton collections were made at stations 82 and 59. The collections were frozen in toto and have been sent to the N.M.F.S. Technology Lab, Ann Arbor.

We were unable to obtain clams for heavy metal analysis. The arrangement to meet a commercial clam dredger did not materialize.

Sediment cores were taken at New York Bight stations 36, 64, 82, 39, B2, 59, 70, and G2, off Barnegat Bay station BB, and at the Delaware Bay waste disposal area. (Stations BW "FA", BW "FB", FLR, and D5. These cores have been sent to the Technology Lab, Ann Arbor, for analysis.

Filets of muscle tissue and liver tissue were removed from finfishes and were sent to Ann Arbor. Only muscle tissue was sent from the samples of scup and butterfish. Tissues from individual fish were kept separate and labelled in the manner described in the report for Challenger cruise 1CH1. Individual fish of each species are designated on the labels by the total length of the fish in mm.

Gill, liver, and muscle tissues were removed from crabs and lobsters. In the case of the crabs, *Cancer irroratus*, tissues removed from several crabs at each station were combined, i.e., each station is represented by gill, liver and muscle tissues for several crabs.

Tissues from individual lobsters were not combined and represent each individual lobster processed (see Table II).

Six moon snails, *Lunatia heros*, were measured (shell length), shells removed and the whole body for each snail was bagged individually (see Table II).

Jack B. Pearce

Jack B. Pearce
Assistant Laboratory Director

Table 1:--Collections of finfish made during R. V. *Dolphin* cruise 1DO2, 25-27 V 1971. Sampling station, collecting gear and species taken are given for each collection.

May 26, 1971; R. V. Dolphin collections of finfish made at Delaware Bay waste disposal area. Station D5 finfish trawl # 1; individuals marked with an * have been sent to the NMFS Technology Lab, Ann Arbor, Michigan.

Species	Total length in mm				
Winter flounder					
Pseudopleuronectes americanus	332	295			
Summer flounder					
Paralichthys dentatus	375	370	327	345	
Windowpane flounder					
Scophthalmus aquosus	240	210	220	230	230
	240	240	250	250	250
	250	250	260	270	270
	280				
Butterfish					
Poronotus triancanthus	184*	148*	136*	136*	125
	116*	112*	110*	113*	107
	119	110	103	116	103
	110	120	104	120	103
	112	117			
Scup					
Stenotomus versicolor	129*	123*	120*	118*	109
	117*	120*	120*	110*	105
	110	105	108	95	112
	102	111	115	111	104
	110	105	105	106	

Species	Total length in mm				
Sea robin					
Prionotus carolinus	200	200	200	200	200
	215	215	215	230	230
	210	210	210	210	210
	215	215	215	230	230
	210	210	210	210	210
	215	215	215	230	230
	210	215	215	230	230
	215	215	215	230	230
	210	215	230	230	230
	230	230	240	240	240
	230	240	240	240	240
	240	250	250	250	260
	240	250	250	250	260
	260	270	280	290	160
	260	280	280	160	170
	170	180	190	170	190
Skate					
Raja sp.	372	307	460	440	500
	311	420	430	460	430
	400				
Smooth dogfish					
Mustelus canis	total 2 (not measured)				

May 26, 1971; Station D5 finfish trawl # 2

Species	Total length in mm				
Winter flounder					
Pseudopleuronectes americanus	304*	250*	221*	290*	
Windowpane flounder					
Scophthalmus aquosus	249*	252*	231*	265*	218*
(following fish also dissected to obtain tissues for pathological analysis)	234*	264*	250*	242*	265*
Sea robin					
Prionotus carolinus	238*	247*	250*	260*	237*
	235*	241*	236*	259*	240*
	309	295	240	260	271
	252	280	230	278	283
	240	263	226	212	251
	282	335	127	219	275
	260	255	265	221	
	250	249	243	225	
Smooth dogfish					
Mustelus canis	780	870	870	870	675
	720	730	570	570	750
	1000	1090	900	830	
	plus 4 lost - estimated at 580-600 mm total 18 fish				
Spiny dogfish					
Squalus acanthias	940	890			
Goosefish					
Lophius americanus	950				
Skates					
Raja sp.	total 8 (not measured)				
Scup					
Stenotomus versicolor	total 50 (not measured)				

May 27, 1971; R. V. Dolphin collections of finfish made at Barnegat Bay control station. Station BB; finfish trawl # 1.

Species	Total length in mm				
Winter flounder					
Pseudopleuronectes americanus	250*	255*	290*	229*	275*
	246*	312*	262*	300*	275*
	300	255	355	331	275
	331	270	270	295	212
	220	235	312	275	236
	240	230	350	222	216
	210	198	270	212	255
	250	190	210	251	275
	210	250	215	252	252
	221	210	235	194	250
	plus 24 fish not measured				
	total 74 fish				
Windowpane flounder					
Scophthalmus aquosus	271*	258*	235*	265*	260*
(following fish (*) also dissected	266*	263*	282*	280*	273*
for pathological analysis)	281	270	240	275	250
	260	232	290	250	265
	275	230	295	252	241
	235	270	211	272	250
	295	221	230	255	310
	255	205	220	251	240
	265	280	300	230	280
	265	325	250	224	295
Scup					
Stenotomus versicolor	151*	132*	132*	125*	134*
	125*	122*	129*	120*	138*
	109	121	145	100	100
	122	122	116	110	124
	111	111	126	105	105
	116	125	115	106	104
	104	105	110	106	105
	125	110	100	102	102
	111	109	124	121	120
	131	125	101	125	105
	105	109	106	130	110
	105	131	107	106	111
	119	111			

Species	Total length in mm				
Butterfish					
Poronotus triacanthus	170*	146*	140*	137*	140*
	136*	135*	131*	134*	125*
	123	126	110	126	115
	130	110	110		
Whiting					
Merluccius bilinearis	232	215	340	364	239
Summer flounder					
Paralichthys dentatus	330	360			
Yellowtail					
Limanda ferruginea	332				
Herring					
Alosa spp.	160	295	286	283	160
	150	330	276	280	150
	155	260	280	140	145
	150	295	285	155	140
	152	140	292	140	150
	145	140	270	141	310
	146	150	286	135	300
	146	151	265	150	295
	133	146	280	146	301
	350	147	295	162	295
	also 65 not measured - total 115 fish				
Sea robin					
Prionotus carolinus	290*	235*	240	125	
Skates					
Raja sp.	340	410	385	300	385
	366	335	452	355	384
	326	454	345	320	415
	330	465	370	440	415
	325	360	440	460	

Species	Total length in mm
Sturgeon	
Acipenser sp.	1050
Spiny dogfish	
Squalus acanthias	1000

May 27, 1971; R. V. Dolphin collections of finfish made at New York Bight sewage sludge disposal site. Station 70 finfish trawls # 1, # 2, and # 3 combined.

Species	Total length in mm				
Winter flounder					
Pseudopleuronectes americanus	279*	256*	285*	221*	210*
	274*	272*	264*	215*	197*
	290	202	200		
	also 5 not measured				
	total 18 fish				
Windowpane flounder					
Scophthalmus aquosus	185*	254*	242*	270*	
	plus 7 not measured				
	total 11 fish				
Yellowtail flounder					
Limanda ferruginea	334*	319*	306*	275*	200*
	343*	305*	257*	223*	209*
	125	207	200	200	189
	212	196	211		
Ling					
Urophycis sp.	400	275	360	336	291
	300	314	335	468	238
	431	373	365	379	461
	326	356	250	186	320
	311	285			
Skates					
Raja sp.	335	480	465	325	350
	444	500	340	505	330
	370	410	405	250	312
	410	370	409	370	

Species	Total length in mm		
Longhorn sculpin *Myoxocephalus octodecimspinosus*	275*	250*	260*
Sea robin *Prionotus carolinus*	232		
Spiny dogfish *Squalus acanthias*	900		
Fourspot flounder *Paralichthys oblongus*	250		
Goosefish *Lophius americanus*	680	600	800
Seabass *Centropristes striatus*	237		
Ocean pout *Macrozoarces americanus*	500		

Table II:--Collections of crab, *Cancer irroratus*, lobster, *Homarus americanus*, and moon snail, *Lunatia heros*, made during *Dolphin* cruise 1DO2, 25-27 V 1971. Data include carapace width for crabs, thorax length for lobsters and depth of shell for snails as well as notes on sex, reproductive and moulting conditions, final disposition for each individual animal, and a list of other invertebrates collected.

May 27, 1971; Station 70, Loran fix 1H5-3200 x 1H4-3635 eastern border of New York sewage sludge disposal grounds. Individuals marked with an * have been sent to Ann Arbor Technology Lab, Ann Arbor, Michigan, for heavy metal analysis.

Rock crab, *Cancer irroratus*

Carapace wd., mm	Sex	Condition	Disposition
123.4*	M	Paper	Gill, liver, and muscle separated from each crab and combined to form single samples of gill, liver and muscle tissue
118.7*	M	"	
123.6*	M	"	
112.1*	M	"	
107.1*	M	Hard	
103.8*	M	"	
109.2*	M	Paper	
107.9*	M	"	
104.1*	M	Hard	
98.1*	M	Paper	
93.0	M	Hard	
105.9	M	Paper	
92.2	M	Hard	
92.8	M	Paper	
80.3	M	Hard	
79.0	M	"	
91.5	M	"	
73.9	M	Soft shell	

Total 18 crabs, approximately 25 crabs taken to Oxford, Md. for pathological analysis.

Lobster, *Homarus americanus*

Thorax length, mm	Sex	Disposition
36*	M	Gill, liver and muscle separated from each lobster and sent as individual packets of tissue from individual lobsters
32*	F	
26*	M	

Horseshoe crab, *Limulus polyphemus*

total - 4 crabs

May 26, 1971; Station D5; Loran fix 3H5-3151 x 3H4-3424, center of Delaware Bay sludge disposal grounds.

Rock crab, *Cancer irroratus*

Carapace wd., mm	Sex	Condition	Disposition
91.5*	F	Hard - not ovigerous	Same as Sta. 70
55.7	M	Soft shell	

Rock crab, *Cancer borealis*

26.5

Horseshoe crab, *Limulus polyphemus*

Total - 4 crabs

Squid, *Loligo pealei*

Total - 36 squid

May 27, 1971; Station BB; Loran fix 3H5-3196 x 3H4-4260. Control station off Barnegat Bay.

Rock crab, *Cancer irroratus*

Carapace wd., mm	Sex	Condition	Disposition
109.8*	M	Hard	Same
74.1*	F	"	
54.1	F	Paper	
41.9	M	Hard	

Moon snail, *Lunatia heros*

Shell length	Disposition
94.3*	The shell was removed from each snail and sent as individual packets of the whole body from individual snails.
75.4*	
72.7*	
71.1*	
62.6*	
55.9*	

Table III:--Serial numbers, station numbers and date, hour and position of surface and bottom drifters released on 25-27 V 1971.

ADDENDUM NO. 1 (SAILING ORDER NO. D-71-7R/V DOLPHIN)

Current Drifters Bottom Number		Surface Number		Station	Hour	Date
059651-059660	(10)	9269-9280	(12)	36	10:07	5/25/71
059661-059670	(20)	9281-9300	(20)	64	10:40	5/25/71
059671-059690	(20)	9301-9310	(10)	82	11:12	5/25/71
059691-059700	(10)	9311-9320	(10)	59	14:37	5/25/71
059706-059710	(5)	9321-9330	(10)	B-2	15:35	5/25/71
059716-059725	(10)	9331-9340	(10)	70	15:58	5/25/71
059726-059735	(10)	9341-9350	(10)	G-2	16:35	5/25/71
059736-059760	(25)	9351-9370	(20)	BB	16:44	5/26/71
059761-059770	(10)	9371-9380	(10)	Wh. Buoy BW "FA"	04:15	5/26/71
059771-059790	(20)	9381-9400	(20)	D-5	05:30	5/26/71
059791-059800	(10)	9401-9408	(8)	Wh. Buoy BW "FB"	10:05	5/26/71
059806-059810	(5)	None		Wh. Buoy FLR	10:25	5/26/71

Disregard bottom drifters 059711-059715 - release point uncertain

Table IV:--Temperature, salinity and dissolved oxygen measured at Stations 82, 59, D5, and BB.

Station S2 (New York Bight dredging spoils disposal area)

	Surface	Bottom
Salinity	27.55	31.14
Temperature	11.36	9.84
Dissolved Oxygen	9.1	6.5

Station 59 (New York Bight sewer sludge disposal site)

	Surface	Bottom
Salinity	28.08	31.68
Temperature	11.63	6.59
Dissolved Oxygen	9.5	7.2

Station BB (Barnegat control site)

	Surface	Bottom
Salinity	33.70	31.92
Temperature	10.40	5.68
Dissolved Oxygen	8.5	7.3

Station D5 (Delaware Bay waste disposal site)

	Surface	Bottom
Salinity	30.5	30.9
Temperature	12.6	12.3
Dissolved Oxygen	9.0	8.8

Table V:--Sediment cores taken during R. V. Dolphin cruise 1DO2, 25-27 V 1971.

Cruise/Strata-Station/Type Sample

1DO2/1-36/sediment
1DO2/1-64/ "
1DO2/1-82/ "
1DO2/1-39/ "
1DO2/1-59/ "
1DO2/1-70/ "
1DO2/1-B2/ "
1DO2/1-G2/ "
1DO2/73-BB/ "
1DO2/69-D5/ "
1DO2/69-BW"FA"/ "
1DO2/69-BW"FB"/ "
1DO2/69-FLR/ "

APPENDIX H

SUMMARY OF SPECIES COLLECTED FOR
ANALYSIS OFF CHINCOTEAGUE, VA.

Cruise #1 3/16/71

1-CY-1/S-1/DG 1-10	Spiny dogfish	*Squalus acanthias*
1-CY-1/S-2/WP 1-10	Windowpane	*Scophthalmus aquosus*
1-CY-1/S-3/RH 1-10	Atlantic herring	*Clupea harengus*

Cruise #2 3/17/71

1-CY-2/S-2/WF 1-10	Winter flounder	*Pseudopleuronectes americanus*
1-CY-2/S-2/FM 1-10	Flat herring	*Alosa* sp.
1-CY-2/S-2/MAC1-10	Atlantic mackerel	*Scomber scombrus*

Cruise #3 3/23/71

1-CY-3/S-1/RF 1-10	Striped bass	*Morone saxatilis*
1-CY-3/S-1/BN 1-10	Blueback herring	*Alosa aestivalis*

Cruise #4 3/25/71

No new species.

Cruise #5 4/15/71

1-CY-5/S-1/WK 1-10	Weakfish	*Cynoscion regalis*
1-CY-5/S-2/WG 1-10	Silver hake	*Merluccius bilinearis*
1-CY-5/S-2/SL 1-10	Spotted hake	*Urophycis regius*
1-CY-5/S-2/CI 1-10	Cancer crab	*Cancer irroratus*
1-CY-5/S-3/WP 1-10	Windowpane	*Scophthalmus aquosus*
1-CY-5/S-A/SS 1-10	Surf clam	*Spisula solidissima*

Cruise #6 5/18/71

1-CY-6/S-1/SK 1-10	Sand tiger	*Odontaspis taurus*
1-CY-6/S-2/BU 1-10	Butterfish	*Peprilus triacanthus*
1-CY-6/S-3/SR 1-10	Northern searobin	*Prionotus carolinus*
1-CY-6/S-3/WP 1-10	Windowpane	*Scophthalmus aquosus*
1-CY-6/S-A/SS 1-10	Surf clam	*Spisula solidissima*
1-CY-6/S-2/CI 1-10	Cancer crab	*Cancer irroratus*
1-CY-6/S-1/MM 1-10	Hard clam	*Mercenaria mercenaria*
1-CY-6/S-3/BC 1-5	Blood clam	*Noetia ponderosa*

Cruise #7 6/22/71

1-CY-7/S-3/WP 1-10	Windowpane	*Scophthalmus aquosus*
1-CY-7/S-2/BS 1-10	Bull shark	*Carcharhinus leucas*
1-CY-7/S-2/SQ 1-10	Long finned squid	*Loligo pealei*
1-CY-7/S-3/CI 1-10	Cancer crab	*Cancer irroratus*
1-CY-7/S-A/SS 1-10	Surf clam	*Spisula solidissima*
1-CY-7/S-3/PKT	Plankton	

List of Fish Collected at the Chincoteague, Virginia Study Site

Fish		Cruise Number I	II	III	IV	V	VI	VII
Spiny dogfish	*Squalus acanthias*	52	52	47	3	31	1	–
Sand tiger	*Odontaspis taurus*	–	–	–	–	–	128	–
Bull shark	*Carcharhinus leucas*	–	–	–	–	–	–	5
Smooth dogfish	*Mustelus canis*	–	–	–	–	–	–	24
Atlantic angel shark	*Squatina dumerili*	–	–	–	–	–	–	3
Clearnose skate	*Raja eglanteria*	–	–	–	–	–	–	48
Unidentified skates	*Raja* sp.	24	13	5	8	110	54	–
Roughtail stingray	*Dysyatis centroura*	–	–	–	–	–	–	8
Bullnose ray	*Myliobathis freminvillei*	–	–	–	–	–	–	8
Blueback herring	*Alosa aestivalis*							
Alewife	*Alosa pseudoharengus*	92	178	183	283	143	91	–
American shad	*Alosa sapidissima*	–	2	1	–	–	17	–
Atlantic herring	*Clupea harengus*	87	112	46	23	18	44	–
Atlantic menhaden	*Brevoortia tyrannus*	1	–	1	17	–	–	–
Bay anchovy	*Anchoa mitchilli*	13	200+	3	–	–	200+	–
Goosefish	*Lophius americanus*	1	–	–	–	5	9	–
Silver hake	*Merluccius bilinearis*	1	6	5	2	359	43	8
Red hake	*Urophycis chuss*				–			–
White hake	*Urophycis tenuis*	3	3	1	–	36	37	–
Spotted hake	*Urophycis regius*	2	–	–	–		65	39
Atlantic cod	*Gadus morhua*	–	1	–	–	–	–	–

Ocean pout	*Macrozoarces americanus*	4	1	–	1	–	–	–
Striped bass	*Morone saxatilis*	4	2	14	9	1	1	–
White perch	*Morone americana*	–	–	–	–	–	–	2
Black sea bass	*Centropristis striata*	–	–	–	–	2	5	32
Scup	*Stenotomus chrysops*	–	–	–	–	–	19	33
Pigfish	*Orthopristis chrysoptera*	–	–	–	–	–	1	–
Weakfish	*Cynoscion regalis*	–	–	–	–	12	353	149
Northern kingfish	*Menticirrhus saxatilis*	–	–	–	–	–	33	41
Atlantic mackerel	*Scomber scombrus*	1	34	30	8	10	1	–
Butterfish	*Peprilus triacanthus*	–	–	–	–	1	5,379	235
Northern sea robin	*Prionotus carolinus*	–	–	–	–	–	247	5,109
Striped sea robin	*Prionotus evolans*	–	–	–	–	–	23	39
Longhorn sculpin	*Myoxcephalus octodecemspinosus*	3	2	2	3	1	–	–
Smallmouth flounder	*Etropus microstomus*	1	2	–	–	2	6	33
Summer flounder	*Paralichthys dentatus*	–	–	–	2	12	37	70
Windowpane	*Scophthalmus aquosus*	669	271	301	272	476	171	84
Witch flounder	*Glyptocephalus cynoglossus*	1	1	4	–	1	–	–
Winter flounder	*Pseudopleuronectes americanus*	19	33	23	36	19	9	–
Spiny boxfish	*Ostracion diaphanum*	–	–	–	–	–	–	1
Northern puffer	*Sphoeroides maculatus*	–	–	–	–	–	17	–
Cruise Totals		978	913	666	667	1,289	6,881	5,970

List of Invertebrates Collected at the Chincoteague, Virginia Study Site

Invertebrates		Cruise Number I	II	III	IV	V	VI	VII
Horseshoe crab	*Limulus polyphemus*	12	73	50	45	68	470	27
Hermit crab	*Paguridae*	–	–	–	–	–	11	*
Lady crab	*Ovalipes ocellatus*	12	4	7	–	39	7	3
Rock crab	*Cancer irroratus*	266	73	89	73	340	23	50
Spider crab	*Libinia* sp.	–	2	20	–	53	77	72
Shrimp	*Crangon* sp.	66	1	–	–	–	–	–
Moon snail	*Polynices* sp.	1	–	–	–	–	9	3
Conch	*Busycon* sp.	2	5	–	–	26	110	103
Longfinned squid	*Loligo pealei*	–	–	–	–	2	40	97
Starfish		28	325	–	–	–	–	*
Sea mouse		–	–	–	–	1	–	–
Cruise Totals		387	483	166	118	529	749	364

* Present but not counted.

APPENDIX I

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 640, Ann Arbor, Michigan 48107

Date: May 12, 1971

Reply to Attn of: FF317

Subject: Analytical Results for March Collection - Dump Site Study

To: Laboratory Director, Technological Laboratory, Ann Arbor, Michigan

Attached is a copy of the analytical results that were accumulated to date for the subject collection of marine samples.

All samples from the Sandy Hook collection were made into composites since there was no individual identity. For the Chincoteague collection, individual specimens were ground where feasible and, also a composite was made by taking equal portions from the individuals and combining into one sample.

In the tables attached, if more than one speciman per sample is indicated, it represents a composite of that many individuals.

If there are any questions in regard this data, please contact me as soon as possible.

Richard A. Greig
Technological Laboratory

Attachments

RAG:bp

cc: Mr. Holston
Dr. J. Hanks (Milford)
Dr. R. Hanks (Oxford)
Dr. J. Pearce (Sandy Hook)

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Sample I.D. Chincoteague - March Collection

Field Code [1]	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Av. of Dup.	Metals results in ppm (wet weight basis)											
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
-2/S-2/mac-M	879	10	0.10											
-2/S-2/fh-M	901	10	0.12											
" -L	881	1	0.11											
-2/S-2/wf-M	923	10	<0.1											
-1/S-2/wp-M	927	1	0.22											
"	929	1	0.32											
"	933	1	0.33											
"	935	1	0.29											
"	937	1	0.16											
"	939	1	0.30											
"	941	1	0.23											
"	943	1	0.45											
"	945	1	0.40											
"	946	10	0.34											
-1/S-3/rh-M	968	10	0.14											
-1/S-1/dg-M	973	1	0.56											
"	975	1	0.62											
"	977	1	0.32											
"	979	1	0.47											
"	981	1	0.48											
"	983	1	0.56											
"	987	1	0.42											
"	989	1	0.40											
"	991	1	0.91											
"	992	10	0.48											

Av. = 0.30

Av. = .53

[1] M = muscle
L = liver

(Added to original code)

Dupe

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Sample I.D. Chincoteague - March Collection

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Av. of Dup.	Metals results in ppm (wet weight basis)										
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1-cy-1/5-1/dg-L	996	10	0.24											
1-cy-3/5-1/bh-M	998	1	0.08											
"	999	1	0.09											
"	1000	1	0.08											
"	1001	1	0.12											
"	1002	1	0.08											
1-cy-3/5-1/rf-M	1028	10	0.43											
" -L	1026	10	0.43											
urf clam (whole) 1/	1031	1	<0.05											
"	1032	1	<0.05											
"	1033	1	<0.05											
"	1034	1	<0.05											
"	1035	1	<0.05											
"	1036	5	<0.05											

1/ The surf clam sample obtained from Delaware Bay dump site by A. Merrill in Feb. 1971.

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Sample I.D. Sandy Hook - March Collection

Field 1/ Code	Ann Arbor Laboratory Code	No. of 2/ specimens per sample analyzed	Av. of Dup.	Metals results in ppm (wet weight basis)										
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
Ich1/69-d5-wp-M	1039	10	0.16											
" -L	1047	10	0.23											
Ich1/69-wb-wp-M	1090	10	0.14											
" -L	1093	10	0.19											
Ich1/69-2cm-wp-M	1087	10	0.20											
" -L	1089	10	0.17											
Ich1/73-bb-wp-M	1083	10	0.32											
" -L	1086	10	0.15											
Ich1/69-d5,wf-M	1049	10	0.09											
" -L	1052	10	0.10											
Ich1/69-wb-wf-M	1110	10	0.06											
" -L	1111	10	0.25											
Ich1/69-d5-yf-M	1054	10	0.15											
" -L	1060	10	0.13											
Ich1/73-bb-yf-M	1094	10	0.15											
" -L	1097	10	0.22											

1/ WP = windowpane flounder; WF = winter flounder; YF = yellowtail

2/ Assumed there to be 10, did not count no. for each sample.

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Sample I.D. Sandy Hook - March Collection

Field 1/ Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Av. of Dup.	Metals results in ppm (wet weight basis)										
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1ch1/69-d5-ls-M	1070	10	0.29											
" -L	1074	10												
1ch1/69-d5-op-M	1112	10	0.11											
" -L	1115													
1ch1/69-d5-wt-M	1116	10	0.19											
" -L	1119	10	0.07											
1ch1/69-d5-sh-M	1062	10												
" -L	1064	10	0.21											
1ch1/73-bb-sh-M	1099	10	0.11											
" -L	1101	10	0.15											

1/ LS = longhorn sculpin; OP = ocean pout; WT = whiting; SH = sea herring

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Sample I.D. Sandy Hook - March Collection

Field Code 1/	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Av. of Dup.	Metals results in ppm (wet weight basis)											
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1ch1/69-d5-cc-M	1079	10	0.10											
" -L	1077	10	0.09											
" -G	1078	10	<0.05											
" -E	1076	10	<0.05											
" wb-M (cc)	1065	10	0.27											
" -L	1067	10	0.24											
" -G	1066	10	0.08											
" -E	1068	10	< 0.05											
" 2cm-M (cc)	1081	10	0.15											
" -L	1082	10	0.08											
" -G	1080	10	< 0.05											
1ch1/69-d5-pl	1102	-	< 0.05											
1ch1/69-wb-pl	1106	-												
1ch1/69-d5-pl	1105	-	< 0.05*											

1/ CC = cancer crab; PL = plankton
G = gills; E = eggs

* This plankton sample was freeze dried. The Hg result is on a dry weight basis.

Ann Arbor Code	Species	College Park Tech Lab Data	Ann Arbor Tech Lab Data	Phoenix Memorial Lab Data
614	big eye tuna	1.04	1.04	
		1.05	0.97	
		1.06		
739	lobster tail	0.86	0.68	
		0.81	0.61	
		0.83		
741	lobster tomally	0.65	0.44	
		1.01	0.54	
		0.71	0.40	
			0.38	
763	lobster tail	0.53	0.50	
		0.50	0.48	
		0.51		
352	lobster tail	0.62	0.66	
		0.66	0.76	
		0.57		
765	lobster tomally	0.42	0.31	
		0.39	0.34	
		0.40		
814	flounder	0.10	0.05	
		0.09	0.06	
		0.10		
946	window pane	0.40	0.39	0.47
	flounder	0.40	0.33	0.50
	(March collection)	0.35	0.30	0.41
			0.37	0.47
			0.33	0.51
			0.32	0.45
1039	window pane	0.17	0.19	0.23
	flounder	0.18	0.16	0.24
	(March collection)	0.19	0.16	0.21
			0.17	0.24
			0.11	0.22
				0.19
361	lobster tail	0.22	0.27	
		0.22	0.23	
		0.22		

All data ppm on wet weight basis.

MARCH COLLECTION - DUMP SITE

The following samples have been analyzed by the Phoenix lab only for multielements. The data had not been calculated as of 6/7/71.

Ann Arbor Code	Field Code	Species	Replicates
946	1CY1S2	Windowpane Flounder	4
992	1CY1STA1	Dogfish	1
1039	1CH1/69-D5	Windowpane Flounder	4
1065	1CH1/69-WB	Cancer Crab	1
1121	1CH1/69-F5	Sediment	1
1102	1CH1/69-D5	Plankton	1

APRIL COLLECTION - DUMP SITE

Samples for Multielement (composites) Analyses:

Our Code	I. D.		Field Code
	Sandy Hook		
1218	WP - Liver		73 BB
1219	WP - Muscle		73 BB
1231	WP - Muscle	extras of	73 BB
1232	WP - Liver	" "	73 BB
1313	WP - Muscle		1 - 70
1314	WP - Liver		1 - 70
1243	WP - Muscle		69 - D5
1244	WP - Liver		69 - D5
1286	CI - Muscle		73 BB
1284	CI - Dig. Div.		73 BB
1290	CI - Muscle		69 - D5
1288	CI - Dig. Div.		69 - D5
1291	CI - Muscle		1 - 82
1293	CI - Dig. Div.		1 - 82
1294	CI - Muscle		1 - 70
1296	CI - Dig. Div.		1 - 70
1558 (9 & 60)	Surf Clam - whole		69 - D5
	Oxford		
1446	Surf Clam - Muscle		SA
1447	Surf Clam - Liver		SA
1536	WP - Muscle		S - 3
1537	WP - Liver		S - 3
1570	CI - Muscle		S - 2

All of these samples have been sent to Phoenix Memorial for analyses. None have been sent to Hazelton--probably will be sent by 6/9/71.

APRIL COLLECTION - DUMP SITE

Proposed plankton and sediments to be analyzed for multielements (Phoenix and Hazelton)

Our Code	I. D.	Field Code
1297	Plankton	69 - D5 (April)
1299	Plankton	73 - BB (April)
1301	Plankton	1 - 59 (April)
1104	Plankton	69 - D5 (March)
1107	Plankton	69 - WB (March)
1133	Sediment	D5
1135	Sediment	D5b
1128	Sediment	C6
1363 (4 & 5)	Sediment	C4
1129	Sediment	E6
1360 (1 & 2)	Sediment	E4
1120	Sediment	G6
1345 (6 & 7)	Sediment	G3
1381 (2 & 3)	Sediment	B2
1378 (9 & 80)	Sediment	A4
	Sediment	WBFA
	Sediment	WBFB
	Sediment	WFLR

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Metals results in ppm (wet weight basis)												Length Specim
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co	mm
1 Dol./7388 Windowpane Flounder Muscle	1208	1	0.30 0.39												275
"	1209		0.39 0.40												274
"	1210	1	0.52 0.49												282
"	1211	1	0.30 0.22												255
"	1212	1	0.29 0.35												275
"	1213	1	0.37 0.42												285
"	1214	1	0.50 0.43												279
"	1215	1	0.31 0.24												246
"	1216	1	0.35 0.27												253
"	1217	1	0.21 0.32												244

Av. = 0.35

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Metals results in ppm (wet weight basis)												Length of Specime
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co	mm
1 D01.773BB(cont.)															
Muscle	1219	10	0.44 0.40												
" Liver	1218	10	0.37 0.33												
"(extra) Muscle	1220	1	0.19 0.20												206
"	1221	1	0.15 0.21												253
"	1222	1	0.44 0.35												295
"	1223	1	0.44 0.26 0.36												291
"	1231	11	0.18 0.18												

Sample I.D. Sandy Hook - April Collection

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Metals results in ppm (wet weight basis)											
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1 Dol./69-D5 Windowpane Flounder														
Muscle	1243	10												
Liver	1244	10												
1 Dol./1-70 Windowpane Flounder														
Muscle	1313	10												
Liver	1314	10												
1 Dol./1-70 Winter Flounder														
Muscle	1249	4	0.19 0.16											
Liver	1250	4	0.19 0.24											
1 Dol./73 8B Winter Flounder														
Muscle	1260	8												
Liver	1259	8	0.30 0.41											

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Metals results in ppm (wet weight basis)											
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1 Dol./69-D5 Winter Flounder														
Muscle	1326	10												
Liver	1325	10												
1 Dol./1-70 Yellowtail Flounder														
Muscle	1273	10	0.07 0.05											
Liver	1272	10	0.10 0.09											
1 Dol./169D5 Yellowtail Flounder														
Muscle	1279	4	0.11 0.16											
Liver	1278	10	0.18 0.18											
1 Dol./73 BB Yellowtail Flounder														
Muscle	1335	7												
Liver	1334	7												

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Metals results in ppm (wet weight basis)											
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1 Dol./1-82 Homarus Gills	1280	7	0.09 0.05											
" Liver	1281	7	0.49 0.28											
" Muscle	1282	7	0.40 0.33											
1 Dol./73 BB Cancer Crab Gills	1283	8	0.12 0.05											
" Dig. Div.	1284	8	0.12 0.20											
" Eggs	1285	8	0.05 0.05											
" Muscle	1286	8	0.06 0.06											

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Metals results in ppm (wet weight basis)											
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1 Dol./69-D5 Cancer Crab														
Gills	1287	9	0.05 0.05											
" Dig. Div.	1288	9	0.05 0.08											
" Eggs	1289	9	0.05 0.05											
" Muscle	1290	9	0.10 0.05											
1 Dol./1-82 Cancer Crab														
Gills	1292	10												
" Dig. Div.	1293	10												
" Muscle	1291	10	0.05 0.07											
1 Dol./1-70 Cancer Crab														
Gills	1295	7												
" Dig. Div.	1296	7												
" Muscle	1294	7												

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Metals results in ppm (wet weight basis)											
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1 Dol./69-5 Surf Clam "whole" *	1558	10												
1 Dol./73 BB Yellowtail Flounder Samples marked Pathology														
Muscle	1561	10												
" Liver	1569	10												

* Whole "fleshy" part of animal was ground as received.

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Metals results in ppm (wet weight basis)											
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1-LOU/SA Surf Clam Muscle	1446	10												
" Dig. Div. & Gonad	1447	10												
1-CY5/S2 Whiting Muscle	1468	10												
" Liver	1469	10	0.09 0.10											
1-CY5/S2 Spotted Ling Muscle	1512	10												
" Liver	1514	10	0.17 0.11											
1-CY5/S3 Windowpane Flounder Muscle	1536													
" Liver	1537													

Samp D. Chin gue April Collect

Field Code	Ann Arbor Laboratory Code	No. of specimens per sample analyzed	Metals results in ppm (wet weight basis)											
			Hg	Pb	Cd	As	Se	Th	Cr	Sb	Ag	Ni	Zn	Co
1-CY5/S1 Weakfish Muscle	1490	10												
" Liver	1491	10												
1-CY5/S2 Cancer crab	1571	10												

APPENDIX J

REPORT ON OBSERVATIONS MADE DURING CRUISE 71-1

OF R/V ALBATROSS IV AND RECOMMENDATIONS RESULTING THEREFROM

The following criteria were used as guidelines for evaluating conditions as they existed aboard the R/V ALBATROSS IV and how they might impose restraints upon the prosecution of the mission as outlined in the proposal entitled "Research on Physiological Effects on Living Marine Resources of Environmental Contaminants."

1. How sampling might be effected with minimal disruption of the integrity of the biocoenoses.
2. Whether or not onboard facilities would lend themselves to a situation whereby meaningful laboratory scrutiny could be initiated.
3. How might the efforts of microbiologists impinge upon the various other scientific missions, if at all.

Sampling

Bottom samples:--Bottom types and the number and kinds of on-deck winches will dictate the type of sampling equipment used.

My experience was George's Bank was almost wholly gravel, sand, and rock. There were, however, scattered pockets of mud, and the various channels had mud and/or sand bottoms. Furthermore, where sand occurred, it was found to be very hard packed. Sampling rocky or hard packed sand requires fairly heavy equipment. Unfortunately, only a small scoop and a Deitz-Laforte grab were on board. These, of course, were totally unsuitable for use over hard, rocky, or sandy bottoms. Even when attempts were made to obtain samples where shell and mud were mixed, ofttimes pieces of shell would wedge the jaws open and the sample would be lost during haul-back. Notwithstanding, the ease of handling and the rapidity of collection are strong recommendations for their use over favorable bottoms. In addition, their light weight construction would require no more than two people for their operation; and, they may be tied to small deck winches which do not require skilled personnel for their operation.

Very heavy dredges and grabs would assure a bottom sample reaching the surface, but their use would require their being hauled by hydraulic winches (requiring the services of a skilled crewman). Their use would consume a great deal of time which might become inordinate over an extended cruise, and a platform would have to be constructed to facilitate handling.

Probably a Smith-McKintyre or small orange peel grab would be the most desirable device--heavy enough to assure sample recovery but light enough to assure easy and rapid handling without the use of sophisticated winches.

Since most microbial activity takes place in the top few millimeters of sediment, I strongly recommend considering the use of heavy, self-closing corers, where possible. Experience shows samples obtained by this method allow the observation of the stratification of both sediment and microflora as it occurs in vivo with a minimum of disruption.

Water and plankton samples:--Equipment was not available on board to take water and nannoplankton samples. However, since these samples cannot be satisfactorily preserved for microbiological purposes, that is, they could not be stored for more than a few hours before they are analyzed, their collection would have served no useful purpose. I cannot foresee any problems unique to the ALBATROSS IV involving the mechanics of collecting this type sample.

Dr. Wigley at the NMFS Base at Woods Hole is very familiar with bottom types in the New England area and I am sure is a source of valuable information. He told me WHOI has catalogued air-dried bottom samples from the entire eastern seaboard. Subsamples are doled out from this collection to other research organizations gratis. If the need arises, these samples may be available for chemical analysis.

Onboard facilities

There is an 8' x 12' room on the ALBATROSS IV which is designated "hydro lab" but obviously serves other functions as well, including storage area and lounge. Recording instruments for the expendable bathythermograph are strapped to the wall. If these instruments were removed, this hydro lab could serve very well as a sea-going bacteriology laboratory.

There are two sinks with hot and cold running water and compressed air outlets are situated along the table tops. Vacuum manifolds utilizing the principle of aspiration would preempt the use of vacuum pumps. The room is serviced by 120 volts/ac current which the Chief Engineer informs me fluctuates widely due to the demands made by the rest of the ship.

The ship leaves port with 800 gallons of fresh water on board and has the capacity to generate from 500 to 800 gallons per day depending on the speed at which the engines are run. Water was not rationed and there appears to be a sufficient quantity for microbiological requirements.

There are no facilities for the generation of a flame, therefore, electrical incinerators or alcohol lamps must be used.

Pity the poor overextended, overworked microbiologist who would have need for more refrigerator/freezer space than is available onboard the ALBATROSS IV. It is copious.

Problems with corrosion are nil. I would say any special care or preparation of instruments for onboard use is unwarranted.

The constant roll, pitch, and yaw of the ship will probably be the most severely limiting factor in the onboard analysis of samples. As a rough estimate, I would say routine manipulations would be very nearly

impossible when seas were above five feet or winds above 20 knots. On Cruise 71-1, 118 stations were occupied and, of these, winds of 20 knots or higher were logged at 47 station and 54 stations were occupied on seas that were five feet or higher. Of course, as the scientist gains skills in working with only one hand, these limits would be mitigated.

In my opinion, it is absolutely imperative that as much pre-cruise preparation take place as possible. Since "dry storage" areas are at a premium, I recommend unitizing and containerizing all supplies and equipment. According to the Research Proposal, the microbiologist must be prepared to carry out a broad spectrum of determinative protocols. Since, as this implies, the amount of selective and differential media and supplies necessary for the analysis of even a few samples would be considerable, I strongly recommend the use of miniaturized microbiological methods if at all possible. I also think it would be wise to make use of as much disposable material as possible.

Incubators will have to be modified so trays and racks can be prevented from sliding. There is a paucity of countertop space available, so size and types of incubators must be kept to minimum.

Any instruments such as spectrophotometers, pH meters, etc., would necessarily have to be strapped down. There are instruments aboard which are necessary for the normal functioning of the ship which are more sophisticated and at least as fragile as a pH meter which seem to suffer little or none at all in spite of the constant sway and roll.

Compatability of microbiological missions with the groundfish survey

I suggest the attempt to superimpose a microbiologically-oriented sampling program over a groundfish survey be abandoned for the following reasons:

1. In the groundfish survey a large number of randomly selected stations are occupied. This is in direct conflict with the expressed purpose of the microbiological part of the contaminants study which is to take selected samples at pre-selected sites for microbiological analysis.
2. By its nature, the analysis of samples for microbes would be difficult to mold to the traditional watch of six hours on and six hours off; therefore, I think a minimum of four microbiologists would be necessary to conduct all the necessary manipulations incumbent to an around-the-clock operation. Since the number of scientists on board must be limited to 12 or 13, the force available to the groundfish survey would be reduced. The proficiency and efficiency of that program would then probably suffer commensurately.
3. The spring groundfish survey occupies many stations over an extended period of time. Microbiologists on such a cruise would be forced to endure extremely unfavorable conditions at best; whereas, several cruises of at most a few days duration would allow the microbiologist to operate almost entirely in the friendlier confines of a laboratory ashore.

If such a series of short cruises with the sole purpose of collecting microbiological samples is unrealistic, I suggest that the microbiological phase of each cruise be divorced from the other phases as much as possible.

I suggest:

1. Microbiologists be allowed to establish their own watches, unrelated to other missions of the cruise.
2. Special stations (to be selected at the discretion of the microbiologist) be incorporated into the cruise plans specifically for bottom, water, and plankton samples.

I do not know how flexible the groundfish cruise plans are or to what extent they could accommodate alterations.

APPENDIX K

Distribution of Bottom-dwelling Organisms in the

Delaware Bay Disposal Area

We sampled stations in the Delaware Bay and New York Bight solid waste disposal areas on 30 March, 21 April, 26 May and 23 June 1971. To date, materials collected with the Smith-McIntyre grab sampler (0.1 m^2) at 19 stations in the Delaware Bay disposal area have been sorted and examined for all benthic macrofauna, i.e., organisms larger than 1.00 mm in their greatest dimension.

We found 59 species of invertebrates associated with these samples. These are listed in Table 1. Station B-5 had the greatest species diversity (17 species) and Stations F-5 and Buoy CM were the least diversified with 3 and 2 species respectively. Station B-5 is located approximately one nautical mile north of the designated dumping site (Station D-5; see Fig. 1) and Station F-5 is located approximately one mile south of D-5. Station Buoy CM is located one mile off Cape May Inlet. Four samples collected at Station D-5, the designated point for dumping, were examined for species composition. The counts ranged from 6 to 16. In terms of number of

individuals per sample, one sample from Station D-5 showed the greatest number of individuals, 73/0.1 m^2. This same sample also had the second highest species diversity, 16 species. This high number of individuals was due, however, to a large number of Paraonis fulgens, a polychaete which often is found in aggregates and in high numbers.

Because of the limited number of samples examined to date it would be premature to draw any conclusions in regard to the effects of waste disposal in the Delaware area. We are certain, however, that these practices have, to date, not had the same effects as in the New York Bight. Collections taken during four cruises to the Delaware area showed no indications of the massive accumulation of sludges which we have observed at the New York Bight sewage sludge and and dredging spoils disposal areas.

Perhaps the analyses of sediment cores will reveal an accumulation of heavy metals at the Delaware site. We have found background levels of the following heavy metals at our Barnegat Bay control site (73-BB):

Cu - 0.7 ppm
Pb - 1.5
Zn - 5.0

At the New York Bight disposal areas we found the following high levels:

Station 82 (dredging spoils)

Cu - 620 ppm
Pb - 390
Zn - 134

Station 59 (sewage sludge)

Cu - 368 ppm
Pb - 350
Zn - 94

It is obvious that heavy metal contamination can serve as an index of the effects of waste disposal. There is a good correlation between species diversity and standing crops and the amount of heavy metals present.

June 30, 1971

	A-5	A-6	B-5	B-6	C-5	C-6	$2CM_2$	D-5	D-5A	D-5B	D-5C	D-6	E-5	E-6	F-5	F-6	G-5	G-6	Buoy
nthozoa:																			
Astrangia danae										1									
ydrozoa:																			
Hydractinia echinata																			
hynchocoela		1	2	7	1	1			1	3	1	1	2			3	5		
ematoda	1		10			5		4									3	1	
olychaeta:																			
Cirratulidae	1		1			2	3	7						1		3	2	1	
Dorvilleidae													2					1	
Marphysa belli	1																		
Glyceridae	8		4	1				2					7						
Lumbrineridae	5		10	6		2	4	4	1	3	1	1	2		1		2		
Magelona rosea							1					1				2			
Glycinella torquata																			
Nephtyidae	3	4	2	4	2	2		4	6	9	4	4	2				5		
Armotrypane aulogaster	1				2			1					1				1		
Aricidea jeffreysii	12		1	4		4							2					1	
Paraonis fulgens		1		5		1		24					3				25	2	
Sabellaria vulgaris							13												9
Pholoe minuta				3					1	2		3					3		
Scolelepis squamata		1	1																
Spiophanes bombyx		1	1				1	4	4	25	5	10				2			
Sternaspidae						1													
Syllidae				2															
Terebellidae				1															
haetognatha																	1		
ollusca:																			
Astarte	6	1	6		9	2						3	8	6		1	1	3	
Tellina agilis	1					1	2		1	1				1					

Table 1

	A-5	A-6	B-5	B-6	C-5	C-6	$2CM_2$	D-5	D-5A	D-5B	D-5C	D-6	E-5	E-6	F-5	F-6	G-5	G-6	Buo CM
Spisula solidissima	1																		
Siliqua costata	1																		
Natica pusilla	3		1		3			1				2		1	1		1		
Nassarius trivittatus	1									1									
Lunatia heros				1													1		
Mitrella lunata							3												
Nucula proxima								1	1										
Limatula subauriculata																		1	
Arachnoidea:																			
Acarina																		1	
Crustacea:																			
Copepoda		8	4	13		7		8				7	1	1			5	4	
Cumacea								1						1					
Diastylis sculpta									1										
Leptochelia savignyi	2	1	1	3		2		3					1			2			
Chiridotea coeca								1					1	2					
Chiridotea tuftsi											2	1						1	
Edotea triloba												1							
Cirolana concharum																1			
Aeginina longicornis									4										
Monoculodes edwardsi		4	5	2	6	1		7	2			2	2	1		1		2	
Trichophoxus epistomus		1	2	1	1									1		2			
Byblis serrata		1																	
Unciola irrorata							1		1										
Unciola obliquua					3											7			
Corophium tuberculatum																			1
Hippomedon serratus												1							
Crangon septemspinosus						1	1	1		3		3							
Pagurus longicarpus									1										
Pagurus sp.							6												
Cancer irroratus							1												
Pinnotheres maculatus														1					

Table 1

	A-5	A-6	B-5	B-6	C-5	C-6	$2CM_2$	D-5	D-5A	D-5B	D-5C	D-6	E-5	E-6	F-5	F-6	G-5	G-6	Buo CM
Ectoprocta									1										
Echinodermata:																			
Echinoidea			1		1	2								5					
Echinarachnius parma														10	1	11	1		
Holothuroidea			1																
Total # Species	15	11	17	14	9	15	12	16	15	10	6	14	13	12	3	11	14	12	2
Total # Individuals	47	24	53	53	28	34	37	73	27	51	14	40	34	31	3	35	56	19	10

Table 1

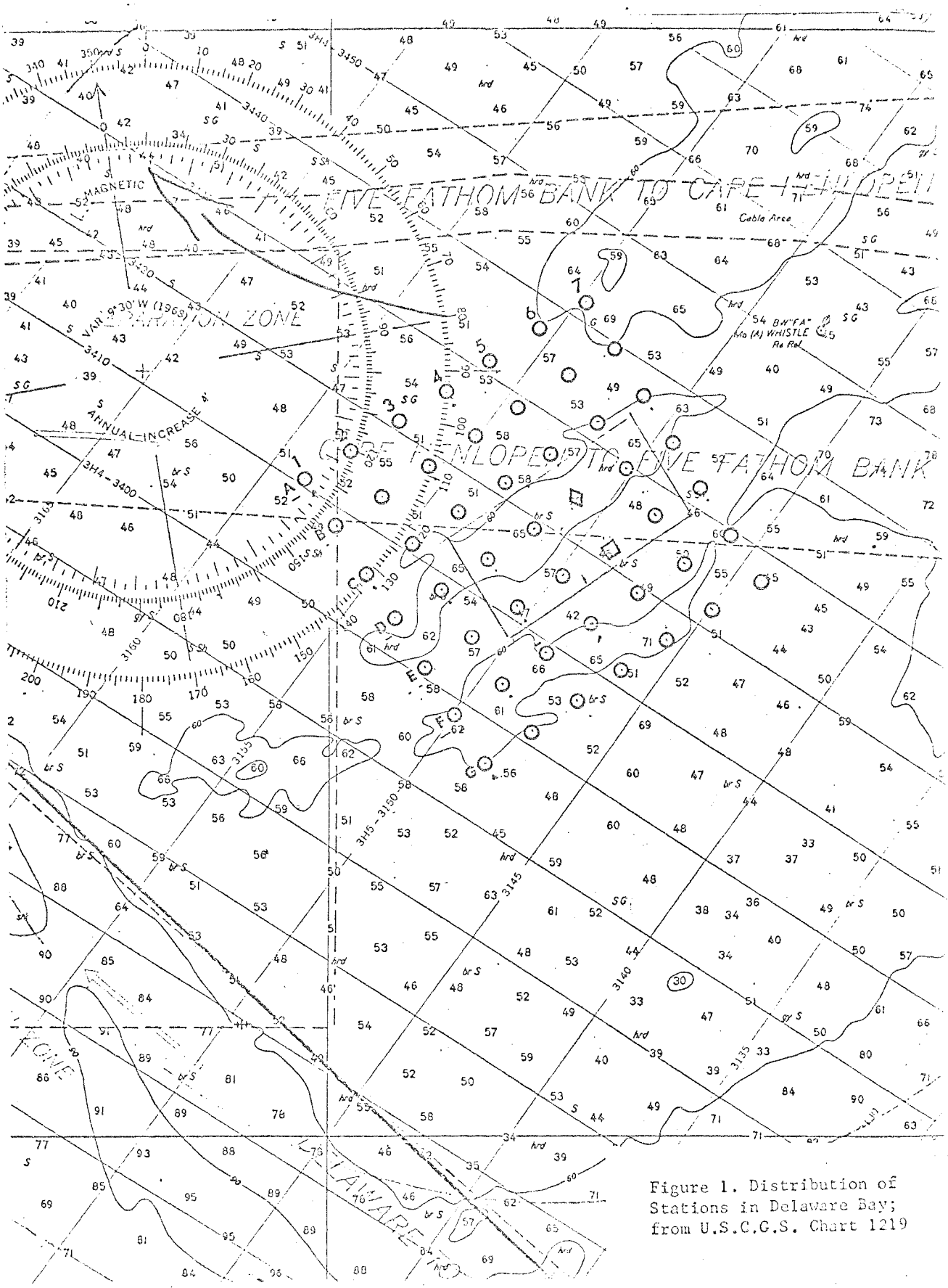
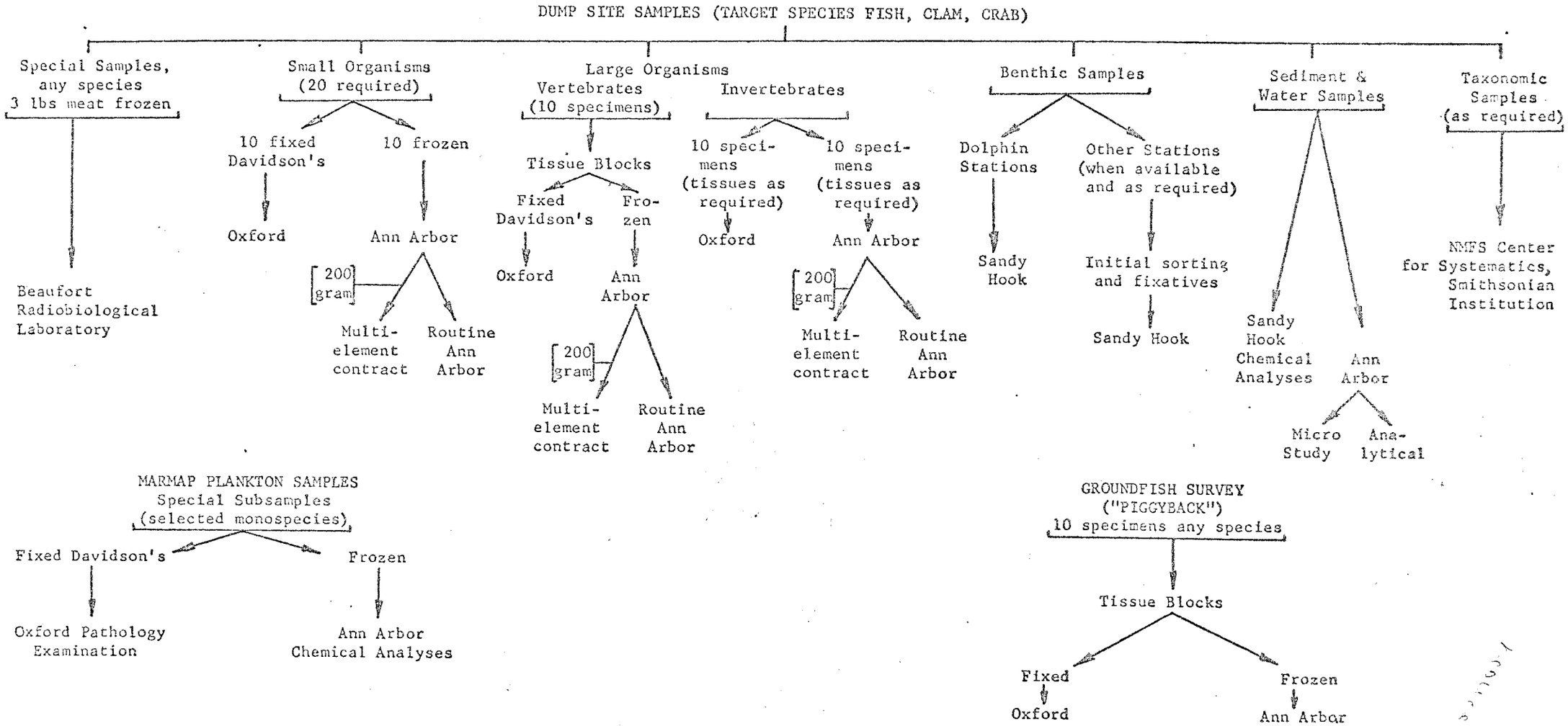


Figure 1. Distribution of Stations in Delaware Bay; from U.S.C.G.S. Chart 1219

APPENDIX L

SAMPLE FLOW DIAGRAM, COOPERATIVE CONTAMINANT STUDY



APPENDIX M

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
Federal Building, 14 Elm Street
Gloucester, Massachusetts 01930

Date: March 18, 1971

Reply to Attn of: FF31

Subject: Temporary appointment: Coordinator, Environmental Quality Program

To: FF314 - Dr. Arthur S. Merrill, Laboratory Director, NMFS Biological Laboratory, Oxford, Maryland

In accord with our recent verbal agreement, this memorandum will formally appoint Dr. Robert Hanks as interim coordinator of the multi-laboratory Regional Environmental Quality Program. The specific purpose of his appointment is to effect a meeting of the minds on the preparations for an implementation of the two spring test cruises--the one involving groundfish survey, commencing on March 9, and the second involving the planning for the studies of dumping sites along the mid-Atlantic Coast. Dr. Hanks' varied experience in water resources research and estuarine ecology uniquely fit him for this temporary assignment. It should be understood that the assignment includes planning of cruises, determination of samples to be taken, as well as development of appropriate techniques for preservation of the samples for their various usages among the several laboratories. In addition, Dr. Hanks will preside over the debriefing sessions following the conclusion of the cruises, and will prepare a report containing his recommendations for the formal program to be initiated by the Milford laboratory, hopefully, on July 1, 1971. Dr. Hanks' appointment will expire automatically upon completion of his report.

John Holston

John A. Holston
Associate Regional Director for
Resource Programs