Cruise Report

W-44

Scientific Activities

Miami - Dominican Republic - Grand Cayman - Miami

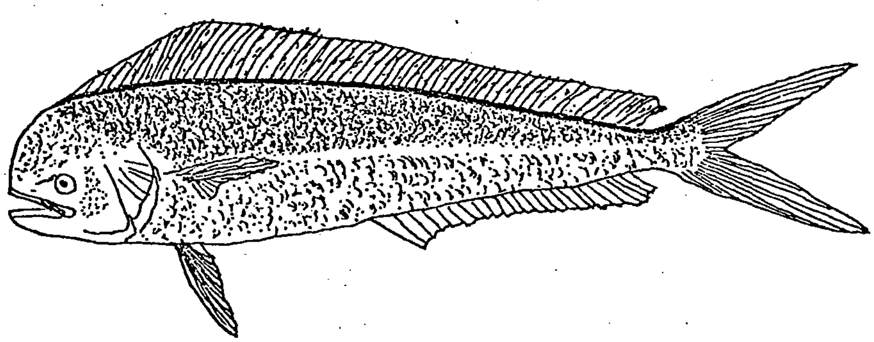
7 February 1979 - 21 March 1979

R/V Westward

Sea Education Association

Woods Hole, Massachusetts

SHIPBOARD DRAFT



PREFACE

The purpose of this Cruise Report is to present a brief outline of the scientific activities completed aboard R/V Westward during W-44. This is accomplished by the presentation of abstracts from the research projects of each student, together with a preliminary integration of their results by members of the staff. In addition, reports of the status of on-going projects and of the traditional academic program are included.

During the cruise, I was able to depend on the patience and skill of a fine crew. I wish to extend special thanks to Abby Ames who was in charge of the shipboard laboratory. Her persistence and ability to continue working under difficult conditions at sea allowed me to depend on her throughout the cruise. In addition, her cheerful attitude and delightful personality were greatly appreciated and enjoyed by staff and students alike.

Jim Quinn participated as an Assistant Scientist on the third leg of the cruise, and contributed much with his knowledge of the physiology of marine mammals. I am sure that the students join me in thanking Jim for his attentiveness, patience and concern during the last few days of report writing!

Two visitors added scientific expertise in different fields. Dr. Tom Hruby of Woods Hole Oceanographic Institution sailed with us on the first leg of the cruise. He supervised a study on the toxicity of phenol on the Sargassum community -- a field of research new to our academic program. The enthusiasm with which he carried out his research program set an example to all of the students with whom he was involved.

Dr. David Isenberg from Haskins Laboratory, Connecticut, accompanied us from the Dominican Republic to Grand Cayman. His interests concerned the song of the humpback whale, and his conscientious and untiring efforts led to several successful recordings.

An additional two visitors were specialists in other fields. Dr. David Drinkwater gave some extremely interesting lectures on the history and philosphy of science that provided a welcome contrast to the scientific lectures given each day. Dr. Paul Strudler, whose specialty was radiochemistry, joined us for the final leg of the cruise.

I also wish to express my sincere thanks to the Captain, Sid Miller, and the other members of the Nautical Staff. Their co-operation and skill in handling Westward allowed us to accomplish the scientific objectives of the cruise with considerable ease.

Finally, where would we have been without food and fish? Gale Gryska did a tremendous job in ensuring that all the culinary suprises dreamed up by the students were, firstly, feasible, and secondly, edible! Gary Manter, our engineer, provided us with much needed samples of dolphin fish -- as well as delicious dinners! My special thanks to them both for their help and company aboard Westward.

This report was composed at sea, and does not represent a detailed interpretation of the data. The limitations of the lack of library facilities and restricted time are clearly reflected in the contents. However, I feel that it is important for the students to be responsible for the completion of their projects while at sea, including writing up a report. The abstracts of these constitute the bulk of this report.

Susan E. Humphris
Chief Scientist
Cruise W-44

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INTRODUCTION

This cruise report provides a record of the research and scientific activities conducted aboard the R/V Westward during the laboratory section of the Introduction to Marine Science course -NS 225 at Boston University.

The itinerary and ship's track for W-44 (Table 1 and Figure 1) provided opportunities for individual student research projects in a variety of oceanographic fields, followed by comparison and integration of many of the results.

The interests of the staff are reflectd in the emphasis placed upon particular aspects of the program.

Research conducted during W-44 partly represents on-going work of individuals and agencies that have extended their assistance to our students. Material reported here should not be excerpted or cited without permission of the Chief Scientist.

Table 1. Itinerary of R/V Westward cruise W-44

	Depart	Date	Arrive	Date
Leg 1	Miami (Florida)	7 Feb. 1979	1/ Puerto Plata (Dominican Republic)	14 Feb. 1979
	Puerto Plata (Dominican Republic)	16 Feb. 1979	Puerto Plata (Dominican Republic)	23 Feb. 1979
Leg 2	Puerto Plata (Dominican Republic)	28 Feb. 1979	Georgetown (Grand Cayman)	10 March 1979
Leg 3	Georgetown (Grand Cayman)	12 March 1979	Miami (Florida)	21 March 1979

1/ Unscheduled stop.

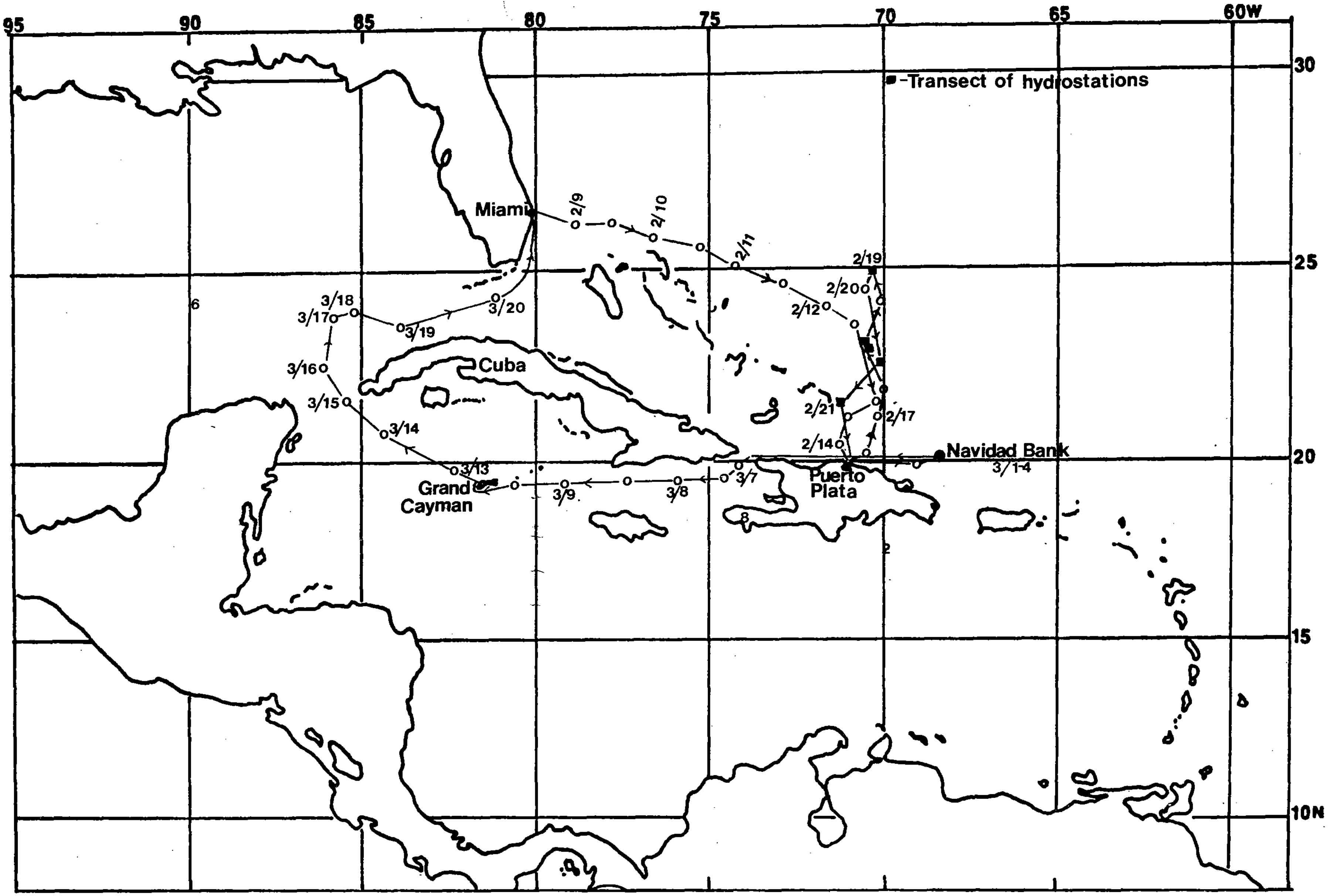


Fig. 1 Cruise track of R/V Westward W-44 (dates indicate midnight positions)

Table 2. Ship's complement for R/V Westward Cruise W-44

Nautical Staff	
Sidney Miller, M.M.	Captain
Richard C. Ogus, B.S.	Chief Mate
Ron H. Harelstad, B.S.	Second Mate
Ellen Farris, A.A.S. (Leg 1)	Third Mate
Paul Nosworthy (Legs 2 and 3)	Third Mate
Gary Manter, A.M.S.	Chief Engineer
Gale Gryska, B.A.	Steward
Scientific Staff	
Melinda A. Ames, B.S.	Scientist - 2
Susan E. Humphris, Ph.D.	Chief Scientist
James V. Quinn, M.S. (Leg 3)	Scientist - 3
Visiting Scientists	
Thomas Hruby, Ph.D.	Woods Hole Oceanographic Institute
David S. Isenberg, Ph.D.	Haskins Lab
Visitors	
David Drinkwater, Ph.D. (Leg 1)	
Paul Strudler, Ph.D. (Leg 3)	

Students

Patrick O. Bartnett, Somerset, N.J. County College, Sophomore, Liberal Arts
Katie H. Beal, University of Connecticut, Junior, Biology
Barbara I. Campbell, Manhattanville College, Junior Biology
Guy Scott Gazelle, Dartmouth, B.S., Biology
Lewis E. Gilbert, Oberlin, Junior, Geology
Robert J. Fierberg, Boston University, Senior, Geography
Dell A. Hendon, Wabash College, Junior, Biology
Nicky N. Hilmer, Connecticut College, Junior, Anthropology
Jeffrey S. Hoadley, Westminster College, Junior, Biology

Students (cont.)

Cindy A. Johnson, University of Vermont, Junior, Biology
Eileen C. Ley, University of Texas (San Antonio), B.S., Biology
Melissa P. Madeira, University of Wisconsin, Sophomore, Undecided
Cyndy J. Malley, Wellesley College, Senior, Chinese
Robert Nawojchik, Cornell University, Senior, Biology
David Neary, Director of Outdoor Education, St. Albans School
Mary D. O'Brien, B.S. in Nursing, Fitchburg (Mass.) State College
Frederick Reis, Southeastern Mass. Univ., Junior, Marine Biology
Nadim Saleeby, University of Pennsylvania, Junior, Political Science
Charles L. Schroeder, Reed College, Junior, Economics
Peter J. Stein, Cornell University, Sophomore, Bio. Engineering
Susan P. Strater, Harvard University, Junior, Biology
Stephanie L. Truesdale, Oberlin, Sophomore, Bio/Env. Studies
Daniel K. Tyler, Purdue, Nat. Resources/Env. Sci., Junior
Caroline A. Woodwell, Carleton College, Junior, English

SCIENTIFIC OBJECTIVES

The scientific research objectives for W-44 were designed to take advantage of the diverse marine environments encountered along Westward's cruise track, as well as providing experience in all aspects of Oceanography. Apart from the routine measurements and analyses conducted aboard Westward, two major research programs were initiated.

On Leg 1, a transect of hydrographic stations from the Sargasso Sea into the southern boundary current was conducted to study the chemical and physical variations that could be interpreted in terms of the history of water masses. In addition, various biological studies were completed, including research on Sargassum weed and its associated community.

In the Dominican Republic, an integrated study of Sosua Beach was made, which included beach surveying, biological studies in intertidal and coral reef environments, and sediment distribution studies.

During Leg 2, a multidisciplinary survey of Navidad Bank was made, including bathymetric profiling, hydrography, light penetration, particulate organic carbon distribution, marine mammal and fish occurrences, planktonic abundance, and nutrient concentrations. This characterisation of Navidad Bank represents a first attempt to determine whether chemical and biological factors influence the migration of the humpback whale, _Megaptera novaeangliae_, to breed on this bank. Hopefully a comparative study on an adjacent bank which the whales do not inhabit for breeding, will be conducted next year.

In Grand Cayman, ecology studies were carried out on a coral reef just outside Georgetown. Territorial behaviorial studies on reef fishes were also completed.

All analyses of samples and processing of data, including photographic records, were completed and discussed in written reports by the students prior to our arrival at Miami, the terminal port for W-44.

ACADEMIC PROGRAM

The academic program aboard Westward was composed of three areas of activity, each of which was given equal emphasis in the final evaluation.

1. Lectures

Lectures in Marine Science were given each week day while at sea, and the topics covered are listed in Table 3 . Many of them were related to either the ship's location or the on-going research activities, while others took advantage of the specialized knowledge of visitors who sailed with us for different legs of the cruise. Information obtained during lectures and science watch was evaluated by means of a written examination (Appendix 1a).

2. Science Watch

The responsibilities of the science watch, which was maintained constantly throughout the cruise, included execution of scientific stations, continuation of the scientific program, and maintenance of the science log. In addition, laboratory and analytical techniques were learned, and time was also made available for individual student research projects, and personal instruction.

A collection of fauna and flora was assembled from different marine environments in an attempt to familiarize the students with the diversity of life in the ocean. This collection served as the basis for study of different phyla, and evaluation in this area was by means of a practical examination (Appendix 1b).

During the last two weeks of the cruise, one student each watch was designated Junior Science Watch Officer. He/she took over the duties previously held by the staff scientist, and was responsible for the efficient running of the laboratory and the scientific program.

3. Individual Research Projects

Each student was required to define and carry out an individual research project. Preparation for these projects was completed while in Woods Hole. All of the projects selected were in fields of natural sciences, although this was not a requirement. Each student was requested to submit a written scientific report before leaving the ship. The abstracts of these papers comprise the bulk of this Cruise Report. In addition, 10-minute presentations of the project and its results were given by each student.

Table 3. Lectures during W-44

1	9 February	The Sargasso Sea	Susan Humphris
2	10 February	History and Philosophy of Science	Tom Hruby David Drinkwater
3	12 February	The age of discovery and economics of islands	David Drinkwater
4	13 February	The scientific method	Tom Hruby
5	16 February	Temperature measurements - BT's and reversing thermometers	Abby Ames
6	17 February	Chemistry of titrations	Susan Humphris
7	20 February	Fish biology	Abby Ames
8	21 February	Spectrophotometric analytical methods	Susan Humphris
9	22 February	Biological environments: I. Rocky and intertidal zone	Tom Hruby
10	1 March	Navidad Bank - program and objectives	Susan Humphris
11	2 March	Long-lining	Abby Ames Susan Humphris
12	3 March	Cetacean noises	David Isenberg
13	5 March	Structure of the Caribbean	Susan Humphris
14	6 March	Natural history of Grand Cayman	Abby Ames
15	7 March	Taxonomic principles	Rob Nawojchik
16	8 March	Whale intelligence: whale songs vs. human speech and other evidence	David Isenberg
17	9 March	Biological environments: II The benthos	Susan Humphris
18	12 March	Phase 3 - objectives and duties of Junior Science Watch Officer	Susan Humphris
19	13 March	Light in the ocean	Susan Humphris
20	14 March	Biological environments: III Mesopelagic ecology	Abby Ames
21	15 March	Adaptations to diving in marine mammals	Jim Quinn
22	16 March	Sargasso Sea - summary of data	Students
23	17 March	Navidad Bank - summary of data	Students
24	18 March	"Feature Creature"review	Fred Reis & Students
25	18 March	Individual projects-discussion	Students
26	20 March	Individual projects-discussion	Students

COOPERATIVE PROGRAMS

Shark Tagging Program (National Marine Fisheries Service)

Patrick Bartnett

In cooperation with the National Marine Fisheries Service, the R/V Westward continues a longlining project to catch, identify, characterize, and tag sharks. The goal of this program is to discover migration patterns of certain species of sharks in the North Atlantic.

During the W-44 cruise, only one longline was set for sharks in the vicinity of Navidad Bank. The longline was baited with whole Spanish mackerel. One shark, which was identified as a *Carcarhinus milberti* (sandbar shark), was retrieved and tagged.

A second shark was caught on a baited trolling line and was also tagged. This shark was identified as a *Carcarhinus falciformis* (silky shark).

Cooperative Ship Weather Observation Program (NOAA)

M. Abby Ames

The R/V Westward is certified to gather weather observations for the U.S.National Weather Service (NOAA) in conjunction with the Organization Meteorologique Mondiale. The observations are made twice daily at 0600 and 1200 GMT and then transmitted to Coast Guard Stations ashore.

On W-44, 49 sets of observations were compiled, of which 40% were successfully transmitted (Table 4). Of these, 65% were copied by NMN Portsmouth, Va., and 35% by NMG New Orleans. Observations made after 22 March were not trasmitted due to radio malfunction.

Table 4. W-44 Ship's Weather Observations.

$99L_aL_aL_a$	$Q_cL_oL_oL_o$	$YYGGi_w$	Nddff	VVwwW	PPPTT	$N_hC_lC_mC_h$	D_sv_sapp	$0T_sT_sT_dT_d$	$1T_wT_wT_w{}^tT$	$3P_wP_wH_wH_w$	$d_wd_wP_wH_wH_w$
99261	70788	09063	12501	99020	19918	115//	00703	06317	12495	30000	34501
99262	70784	09123	33203	99010	19318	313//	11202	05915	12359	30000	11501
99257	70767	10064	13005	99020	20518	1/3/8	22004	06113	12350	30000	30504
99254	70752	10123	70719	98032	20218	734//	22117	06016	12311	30200	33604
99251	70742	11063	80910	98071	23820	813//	31707	05718	12370	30000	05501
99258	70735	11124	70606	98031	23020	5747/	22008	05616	12304	30000	07503
99240	70716	12063	80625	98022	23020	873//	21704	05919	12450	30000	/////
99228	70714	12124	90617	98022	22821	973//	21213	05419	12506	30201	02503
99225	70713	13063	80218	95606	18822	971//	32810	05520	12495	30302	09505
99213	70707	13123	81108	97612	16022	873//	71102	05523	12505	30500	09503
99203	70711	14063	80910	98502	16225	813//	31214	05123	12550	30201	09704
99200	70708	14122	80805	96635	16922	830//	31213	05722	12530	30000	07601
99213	70700	17063	10710	98020	18825	189//	11010	00123	12400	30501	09502
99222	70701	17123	60706	97031	18523	3255/	11210	05218	12455	30100	11501
99227	70701	18063	40406	98021	21223	2159/	81203	05217	12464	30101	00/00
99234	70704	18124	10603	98010	21423	01500	81005	05318	12430	30100	96501
99241	70705	19063	30720	97030	23022	324//	12000	05320	12416	30502	09602
99247	70703	10123	21420	98020	30222	123//	82400	05321	12458	30501	05503
99243	70703	20063	00000	98000	20223	000//	42707	05220	12420	30000	09503
99235	70703	20123	71705	97031	22023	5842/	51210	05321	12486	30201	17804
99223	70702	21063	30913	96251	22923	323//	41005	05322	12506	30000	/////
99217	70701	21123	40925	98018	21923	413//	42008	05422	12500	30404	/////
99213	70708	22063	41020	98188	21923	41///	52004	05422	12492	30404	/////
99200	70704	01063	10000	98000	30524	125//	21403	05120	12495	30000	/////
99195	70694	01113	20708	98030	18824	224//	22211	05124	12523	30000	07702
99201	70684	02063	10605	97010	19923	115//	11008	05122	12549	30202	/////
99195	70691	05063	03408	97010	17523	0////	72002	05318	12537	31202	/////
99204	70707	06063	20501	99020	18523	00050	22208	05520	12551	30302	/////
99200	70742	07063	10910	98020	14824	12300	51701	05423	12620	3////	05502
99195	70744	07123	10708	99020	14824	00640	61308	05318	12659	399//	99/01
99195	70760	08063	30001	97020	14024	00/09	62003	05122	12628	300//	/////
99194	70767	08123	50000	97020	15225	58441	62114	05124	12638	30000	/////
99191	70783	09063	53610	98011	16925	51330	62605	05323	12630	30502	33702
99193	70814	10063	30210	97020	19125	30430	00808	05223	12610	30000	07100
99193	70815	10123	50905	97032	16424	52330	00307	05423	12623	30100	09100
99198	70824	13013	20212	97022	18925	20500	71706	05327	12650	30302	02502
99200	70830	13123	50708	97032	18225	28140	61608	05124	12551	30101	07501
99208	70844	14063	10905	97031	19924	114//	71706	05222	12609	30101	09501
99212	70851	14123	10508	98010	19125	11200	62601	05324	12630	30101	05901
99217	70857	15063	20208	98030	20725	22200	32000	05223	12622	30101	01402
99216	70855	15123	30108	97030	20024	32411	72103	05222	12600	30402	01403
99223	70861	16063	40508	97010	21922	42000	21001	05323	12459	30303	07503
99222	70863	16113	40508	97000	30122	42400	21309	05420	12500	30303	07503
99240	70869	17063	40724	97021	22922	41400	21400	05219	12512	30605	/////
99243	70863	17113	30520	97010	22023	31300	01205	05221	12548	39901	07606
99241	70854	18113	20916	97020	21521	245//	11503	05016	12112	3////	09503
99233	70840	19063	10921	96020	19222	122//	81706	05219	12488	30506	07304
99241	70823	20113	00714	97000	18020	/////	10204	05215	12199	30502	07502
99243	70816	20123	21112	98020	17821	21500	12301	05316	12303	30302	/////

Key: $L_aL_aL_a$ - latitude in degrees and tenths; Q_c - quadrant of globe; $L_oL_oL_o$ - Longitude in degrees and tenths; YY - day of month; GG - Greenwich Mean Time; i_w - wind indicator; N - total cloud amount; dd - wind direction; ff - wind speed; VV - visibility; ww - present weather; W - past weather; ppp - sea level pressure; TT -air temperature; N_h - amount of lowest cloud; C_l - type of low cloud; h - height of lowest cloud; C_m - type of middle cloud; C_h - type of hogh cloud; D_s - course of ship; v_s - speed of ship; a - character of pressure change; pp - amount of pressure change; T_s - air-sea temperature difference; T_d - dew point; T_w - sea temperature; ${}^tT$ - tenths of air temperature; P_w and H_w - wind wave period and height; d_w - swell direction.

Eel larvae distribution

James Hain, University of Rhode Island

The R/V Westward has collected eel larvae for three years in cooperation with Dr. James Hain to study the distribution of the American eel larvae, *Anguilla rostrata*. Data collected are sent to Dr. Hain for analysis.

A Survey of leptocephalus larvae collected in the Sargasso Sea, Caribbean Sea, and Yucatan Straits

Daniel Tyler

ABSTRACT

A survey of leptocephalus larvae was made in plankton tows from the Sargasso Sea, the Caribbean Sea, and the Yucatan Straits. This showed a higher abundance of larvae of the Muraenidae family in the Sargasso Sea, as compared with the Yucatan Straits, where larvae of the Ophichthidae family occur. A correlation was found between the number of eel larvae collected and the time of day. Most larvae were collected at night, which suggests a possible diurnal migration pattern. In addition, many of the larvae were associated with Sargassum weed.

LONG TERM INTERNAL PROGRAMS

Marine Mammals

An ongoing survey of Cetaceans was continued during W-44, with a particularly intense effort concentrated in the area of Navidad Bank. A total of approximately one hundred cetaceans sightings was made, most of which were of humpback whales, Magaptera novaeangliae, on Navidad Bank. In addition, two sightings of dolphins, one of a seal, and two of whales were made, and are recorded in Table 5 . The Navidad Bank sightings are reported separately by Malley. Hydrophone acoustic stations were also undertaken in Navidad Bank, and some good recordings obtained -- these are reported by Isenberg and Gazelle.

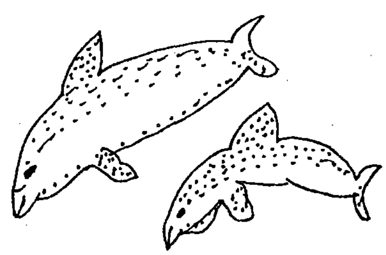


Table 5. Marine Mammals Sighted during W-44 (excluding Navidad Bank)

Common Name	Latin Name	Number	Date	Time	Location
Unidentified seal		1	2/08	0200	Miami Harbor
Unidentified dolphin		2	2/09	2140	25°42′N 76°58′W
Minke whale	Balaenoptera acutorostrata	~30	2/13	1530	21°07′N 71°05′W
Unidentified blows		3	2/18	1045	23°30′N 70°30′W
Saddleback dolphin	Delphinus delphis	10-15	3/12	1645	19°27′N 81°43′W

Bird Observations

Robert Nawojchik

The open ocean provides an unusual habitat for birds. Special adaptations are needed to survive in such a challenging environment. Most oceanic birds are of substantial size with a large wingspan, and their flight habits are conducive to saving energy.

During W-44, bird sightings did not occur very often, and usually consisted of only one bird. Despite this, individuals representing 11 families and 5 orders were seen -- these are listed in Table 6. Not all individuals could be identified to species, and are appropriately labelled.

Table 6. Bird Sightings

Date	Latin Name	Common Name	Position	No.
2/08	Pelecanus occidentalis	brown pelican	Miami	1
2/08	Phalacrocorax auritus	double-crested cormorant	Miami	1
2/08	Larus atricilla	laughing gull	Miami	C*
2/08	Puffinus lherminieri	Audubon's shearwater	25-45N, 79-55W	1
2/08	Larus argentatus	herring full	25-45N, 79-55W	1
2/09	Stercorarius pomarinus	pomarine jaeger	26-10N, 77-49W	1
2/09	Larus sp.	herring(?) gull	26-10N, 77-49W	3
2/09	Sterna sp.	common(?) tern	26-10N, 77-49W	1
2/09	Gelochelidon nilotica	gull-billed tern	26-10N, 77-49W	1
2/10	Puffinus griseus	sooty shear-water	25-26N, 74-40W	1
2/11	Phaethon lepturus	white-tailed tropicbird	24-26N, 72-53W	1
2/13	Stercorarius parasiticus	parasitic jaeger	21-20N, 70-50W	1
2/14	Bubulcus ibis	cattle egret	Puerto Plata	C
2/14	Stelgidopteryx ruficollis	rough-winged swallow	Puerto Plata	C
2/19	Larus marinus	great black-backed gull (immature)	24-57N, 70-18W	1
2/21	Stercorarius sp.	parasitic jaeger (?)	21-34N, 70-15W	1
2/21	Puffinus sp.	Audubon's (?) shearwater	21-34N, 70-15W	1
2/25	Mimus polyglottos(?)	mockingbird(?)	Puerto Plata	C
3/01	Puffinus sp.	(shearwater)	19-57N, 69-02W	1

Bird Sightings (cont.)

Date	Latin Name	Common Name	Position	No.
3/04	Stercorarius parasiticus	parasitic jaeger	19-55N, 70-25W	2
3/08	Puffinus griseus		19-18N, 77-29W	1
3/08	Phaethon lepturus		19-18N, 77-29W	1
3/08	Fregata magnificens	magnificent frigatebird	19-18N, 77-29W	1
3/11	Fregata magnificens		Georgetown	1
3/11	Mimus polyglottos(?)		Georgetown	1
3/12	Fregata magnificens		Georgetown	1
3/13	Tyrannus dominicensis	gray kingbird	20-21N, 83-51W	1
3/14	Gelochelidon nilotica		21-32N, 85-31W	1
3/14	Phaethon lepturus		21-32N, 85-31W	1
3/15	Larus atricilla		22-38N, 86-36W	1
3/18	Stercorarius parasiticus		24-39N, 84-57W	4

* C - Common

Neuston Studies

M. Abby Ames

For more than a year, Westward cruises have routinely carried out neuston tows and certain shipboard analyses of the catch. During W-44, twenty-five neuston tows were conducted and analysed for their contents of tar balls, Sargassum weed, and for the marine insect *Halobates micans*. The results are shown in Table 7.

a) Sargassum weed

Sargassum weed is a primary producer and is of particular interest to us in our long-term study of trophic dynamics in the Sargasso Sea.

Considering data from only the Sargasso Sea, i.e. stations N1-N9, the mean standing crop was 56.9 mg/m^2 (S.D. = 85.6; range = 277), which is very similar to results obtained on W-36 and W-42. However, at one station a large amount of Sargassum was collected, which is responsible in part for this high mean. Station W-44 N9 was located near Navidad Bank and was situated most likely in the boundary current.

b) Tar balls

Tar balls are thought to originate from crude oil lost during tanker washing. Lighter hydrocarbons are evaporated, but the heavier hydrocarbons tend to concentrate into floating balls, which have a residence time of between 6 months and 10 years.

The data collected during W-44 showed a great deal of variability in tar concentration. One tow, W-44 N11, contained a considerable quantity of oil; this station was located in the Windward Passage between Cuba and Hispaniola. Where present, the tar ball contents of tows were higher in the Caribbean Sea and Yucatan Straits, which probably reflects the increase in crude oil shipping in these areas.

c) <u>The distribution of Halobates</u>

Melissa Madeira.

ABSTRACT

Halobates micans, a water strider, is the only insect known to spend its entire life cycle at sea. Previous studies have demonstrated that the population of *Halobates* tends to decrease significantly in the nutrient-poor waters of the Sargasso Sea.

A study was made to determine whether there was a negative correlation between the abundance of *Halobates* and that of Sargassum weed in twenty-five neuston tows made in the Sargasso and Caribbean Seas. The results suggest that no correlation existed between the two. However, it was found that the *Halobates* population increased in areas where productivity was greater, particularly of zooplankton.

Table 7. Summary of W-44 Neuston Tow Results

Tow #	Date	Time	Position N	Position W	Tar balls* (10^{-3}g.m^{-2})	Sargassum (wet wt.) (10^{-3}g.m^{-2})	Halobates (1000/km^2)
W-44N1	2/10	1115	25°30′	75°12′	2.0	15.0	0
W-44N2	2/10	2000	25°09′	74°10′	2.8	7.2	0
W-44N3	2/11	1114	24°13′	72°28′	1.2	6.3	0
W-44N4	2/17	1148	21°50′	70°00′	1.2	47.0	0
W-44N5	2/17	2004	22°30′	70°06′	0.9	31.9	0
W-44N6	2/18	2007	23°46′	70°20′	0.0	0.0	0
W-44N7	2/19	2132	24°47′	70°28′	4.9	121.5	0
W-44N8	2/21	2047	21°19′	70°35′	0.0	6.5	0
W-44N9	3/5	2226	20°15′	71°44′	0.0	277.0	0
W-44N10	3/6	1400	19°55′	73°23′	2.1	8.9	0
W-44N11	3/6	2125	20°00′	74°00′	184.0	195.1	0
W-44N12	3/7	0900	19°38′	74°28′	3.3	12.1	0.8
W-44N13	3/7	2020	19°30′	75°30′	4.9	6.5	4.9
W-44N14	3/8	0005	19°30′	75°57′	0.0	0.0	0
W-44N15	3/8	0900	19°26′	77°04′	2.0	58.1	3.2
W-44N16	3/9	0000	19°17′	78°33′	--	--	--
W-44N17	3/9	1147	19°20′	80°17′	6.0	18.4	0
W-44N18	3/9	2205	19°24′	81°22′	10.5	0.0	1.6
W-44N19	3/9	2335	19°20′	81°24′	0.0	0.0	0
W-44N20	3/10	0020	19°21′	81°25′	0.0	0.0	3.2
W-44N21	3/10	0400	19°19′	81°27′	0.0	0.0	8.9
W-44N22	3/13	0005	19°46′	82°89′	0.8	4.0	55.9
W-44N23	3/14	0005	20°49′	84°21′	0.0	0.0	21.9
W-44N24	3/14	1155	21°26′	85°23′	15.4	8.5	21.1
W-44N25	3/15	1100	22°10′	86°00′	0.8	0.0	4.9

*Calculated concentrations are based on the surface area filtered, calculated from the speed and time of the tow.

SARGASSO SEA STUDIES

Introduction

The Sargasso Sea is composed of a mass of warm, saline water, extending to a depth of about 200m, which represents the center of an asymmetrical anticyclonic gyre in the North Atlantic. It is bounded on the western and northern sides by the Gulf Stream, and on the eastern side by the Canary Current. To the south lies the Antilles Current, which is derived from the Northern Equatorial Current.

The objectives of the scientific program in this area were to identify and characterize the transition between the southern boundary current and the Sargasso Sea water mass, in terms of biological, chemical and physical variables. In addition,phenol toxicity and nutrient requirement studies were carried out on Sargassum weed and its associated community.

The abstracts that follow represent individual research projects undertaken by students.

a) Water mass studies

Surface water masses of the Sargasso Sea

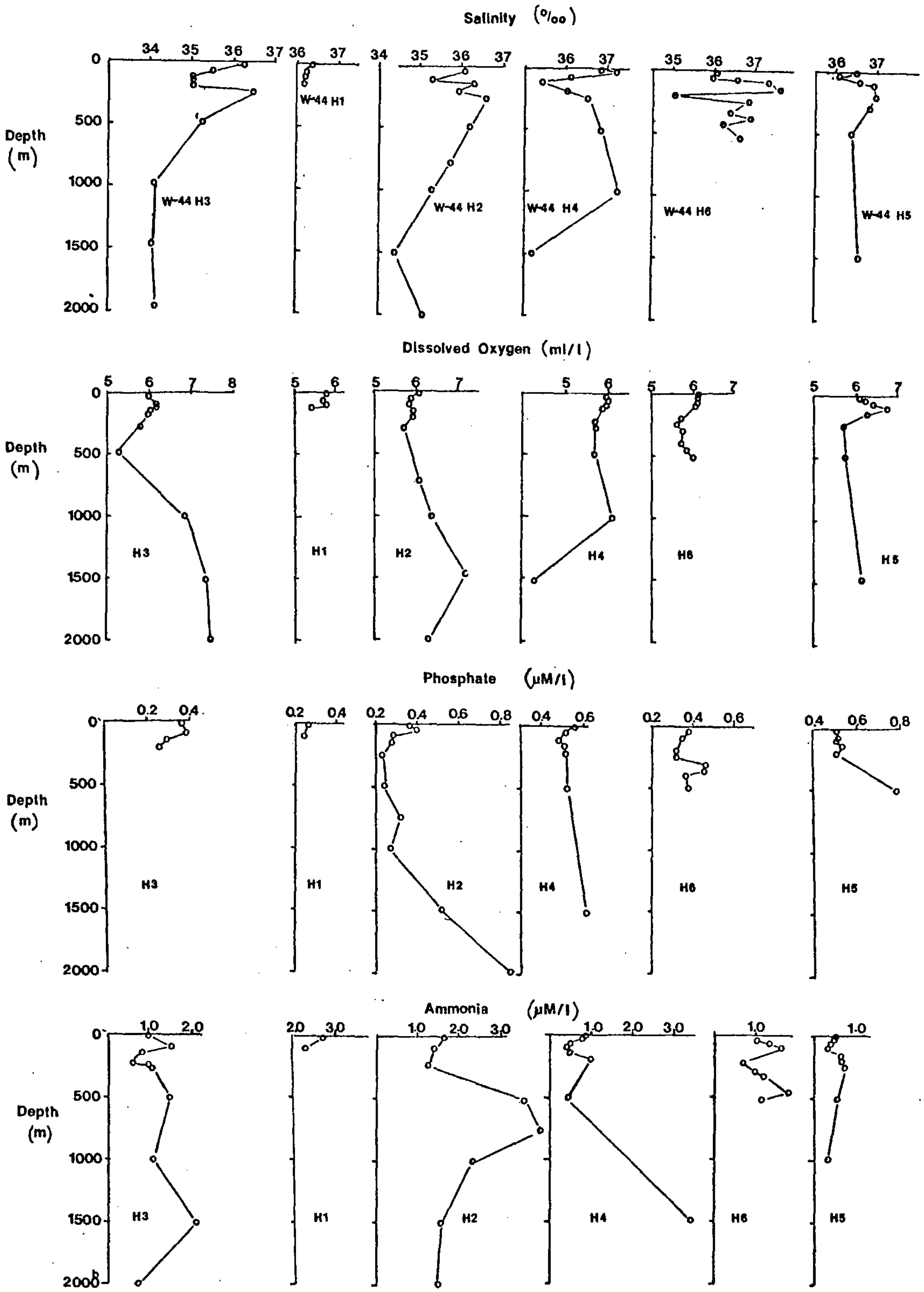
Robert Fierberg

ABSTRACT

The transition from the Sargasso Sea water to the Northern Equatorial Current was studied in a North-South transect of six hydro-stations from 25° - 21.5°N. Temperature, salinity, dissolved oxygen, ammonia and phosphate were determined, and the data are presented in Appendix 2 and Fig. 2.

The Sargasso Sea was characterized by a warm lens of saline water, depleted in nutrients, underlain by a pronounced thermocline at about 200m. The more southerly stations showed higher surface temperatures but a decrease in the depth of the thermocline. They also contained higher nutrient concentrations, which are probably the result of up-welling at the equator, which replenishes the nutrients in the westward-flowing Northern Equatorial Current.

Fig.2 Chemical analyses of stations from the Sargasso Sea — N-S transect.



Biomass Determination, By Oxidation of Particulate Organic Carbon, In the Sargasso Sea

Peter J. Stein

ABSTRACT

Biomass was determined, by wet oxidation of particulate organic carbon with potassium dichromate, for a transect from the interior of the Sargasso Sea to the southern boundary current. Results show a general increase in biomass from the interior to the boundary current. Values rose from 57 to 126 mg C/m^3. This is in agreement with the increase in the nutrient concentrations observed due to the influence of the boundary current in the more southerly stations. The boundary currents inhibit mixing of water resulting in low nutrient concentrations and hence low biomass, in the Sargasso Sea.

Light Penetration in the Sargasso Sea

David Neary

ABSTRACT

Incident light at the ocean surface and at depth was measured at four stations using a Kahl Underwater Irradiameter. The average depth at which the light received would be equivalent to only 1% of the incident light was calculated to be 58m, indicative of water with relatively low productivity.

b) Sargassum community studies

The effect of added nitrate on Sargassum weed productivity

Eileen C. Ley

ABSTRACT

The effect of the addition of nitrate on the productivity of Sargassum weed was determined by measuring respiration rates and gross productivity. It was found that there was an increase in the respiration rate and an overall decrease in the gross productivity.

Phenolics in *Sargassum* spp.

Thomas Hruby

ABSTRACT

Phenolics produced by two species of *Sargassum* were measured spectrophotometrically using the dizao-dye method (Brentamine Fast Red GG) developed by Sieburth and Jensin (1969). Since there is no universally applicable technique for determining absolute concentrations of phenolic substances in crude extracts or exudates from brown algae (Ragen and Craigie, 1978), values were reported as equivalents of anhydrus phloroglucinol (the monomer of the commonest phenolic compound in brown algae).

Specimens of the crab *Planes minutus* and the decapod *Leander tenuicornis* were subject to two concentrations of pure phloroglucinol (5 and 50 ppm wt/wt) for 42 hours, and both concentrations were found to be toxic for the latter species. *Leander tenuicornis* was also exposed to the aqueous exudate from *Sargassum natans* having equivalent concentrations of phenolics, and the observations of its survival suggest that the exudate is more toxic than the phloroglucinol monomer alone.

Ragan, G. A. and Craigie, J. S. 1978. Phenolic compounds in brown and red algae. In: (J. A. Hellebust and J. S. Craigie, eds): *Handbook of Phycological Methods*. Cambridge University Press, p. 157.

Sieburth, J. McN. and Jensen, A. 1969. Studies on algal substances in the sea. II. The formation of Gelbstoff (humic material) by exudates of Phaeophyta. *J. Exp. Mar. Biol. Ecol.*, *3*, 270.

Determination of phenol toxicity in Latreatus fucorum and Portunis sayi

Mary O'Brien and Charles Schroeder

ABSTRACT

The levels of phenol toxicity to organisms of the Sargassum community was determined by placing Sargassum shrimps and crabs in varying concentrations of leached phenolic solution and noting the time for death to occur. Our results indicate no correlation between the time of death and the concentration of phenolic solution. The lack of response to phenol concentration of up to twenty-four parts per million may have implications for aquaculture of Sargassum weed.

NAVIDAD BANK STUDIES.

Introduction.

Navidad Bank is one of a series of shallow banks trending NW-SE off the coast of Hispaniola and Puerto Rico. Several of these banks, including Navidad, are generally regarded as the breeding and calving grounds of the humpback whale, *Megaptera novaeangliae*. The reasons for their migration to this area, and for their selection of particular banks, is not well understood. Heat conservation in the young on the bank, and the ability of the whales to survive on their accumulated lipids in regions of lower productivity and increased water temperatures, are two proposed explanations.

The purpose of our study in this area was to investigate the physical, chemical, and biological characteristics of Navidad Bank in order to determine whether these properties might influence the choice of bank. Hopefully, a comparative study will be completed next year on an adjacent bank to which the whales do not migrate.

The abstracts that follow briefly report the multidisciplinary survey carried out on Navidad Bank, each abstract representing an individual student research project. The ship's track and all scientific stations are shown in Figure 3.

1. Bathymetry.

A series of bathymetric profiles were taken across the bank, and are presented in Figure 4. Although coverage of the bank was too limited to completely define the shape and structure, the crossings demonstrated that the margins deviated somewhat from their charted positions.

The profiles show that the margins of the bank are extremely steep with rough topography, and exhibit a lip-like feature at the edge. The interior of the bank is relatively flat with a depth of between 12-16 fathoms. This bank constitutes part of a very thick formation that includes the Blake-Bahama escarpment, and is composed of carbonates.

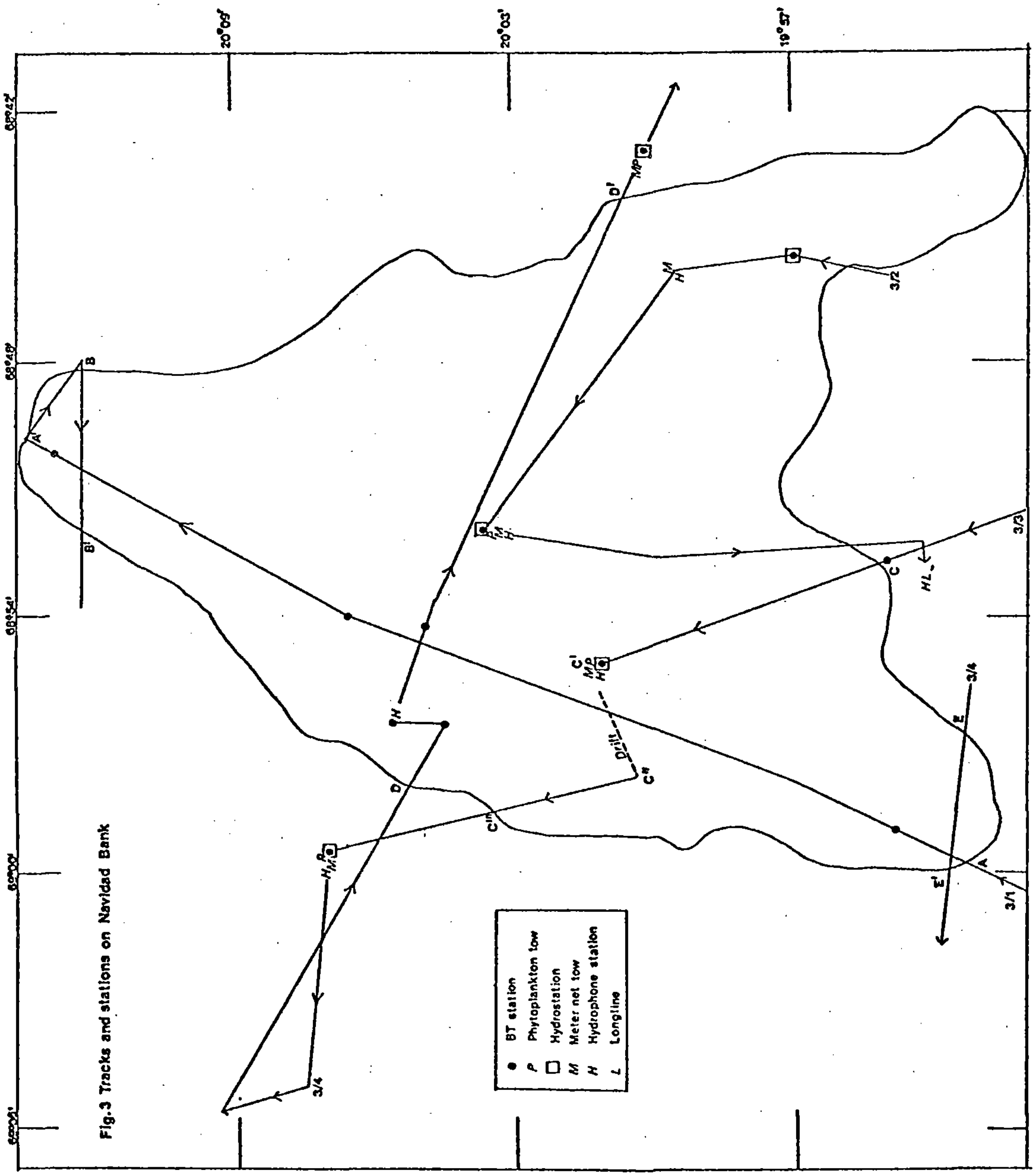
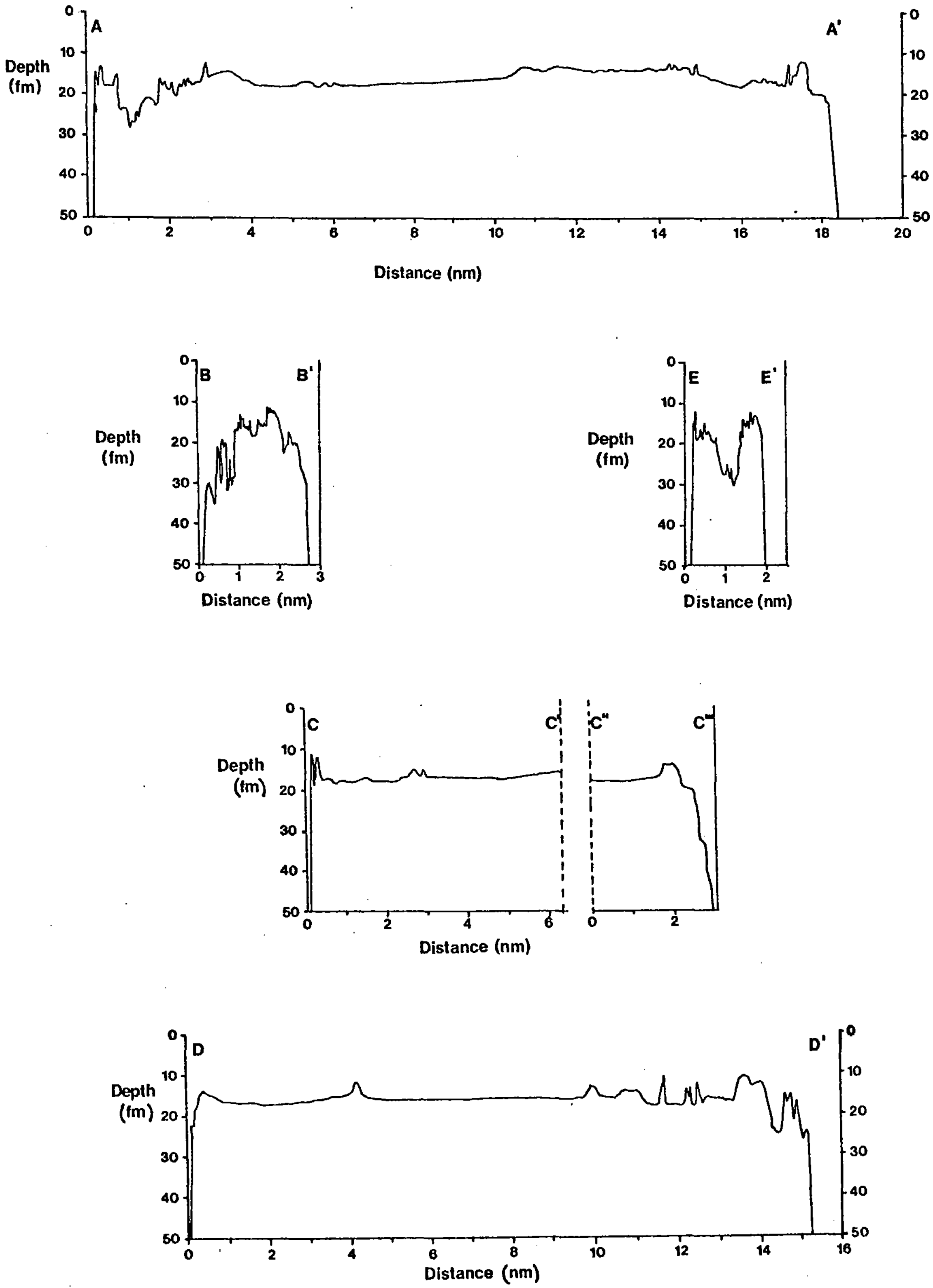


Fig.3 Tracks and stations on Navidad Bank

Fig.4 Bathymetric profiles across Navidad Bank.



2. Water mass studies.

Temperature-depth structure of Navidad Bank.

Cynthia Malley

ABSTRACT

Fifteen bathythermograph profiles were taken on Navidad Bank and its environs, to provide an indicator of the temperature-depth structure of the area.

The bank was found to be warmer than the surrounding waters by an average of 0.3°C and the water column showed a constant temperature with depth. Off the bank the top of the thermocline was observed between 100-150m.

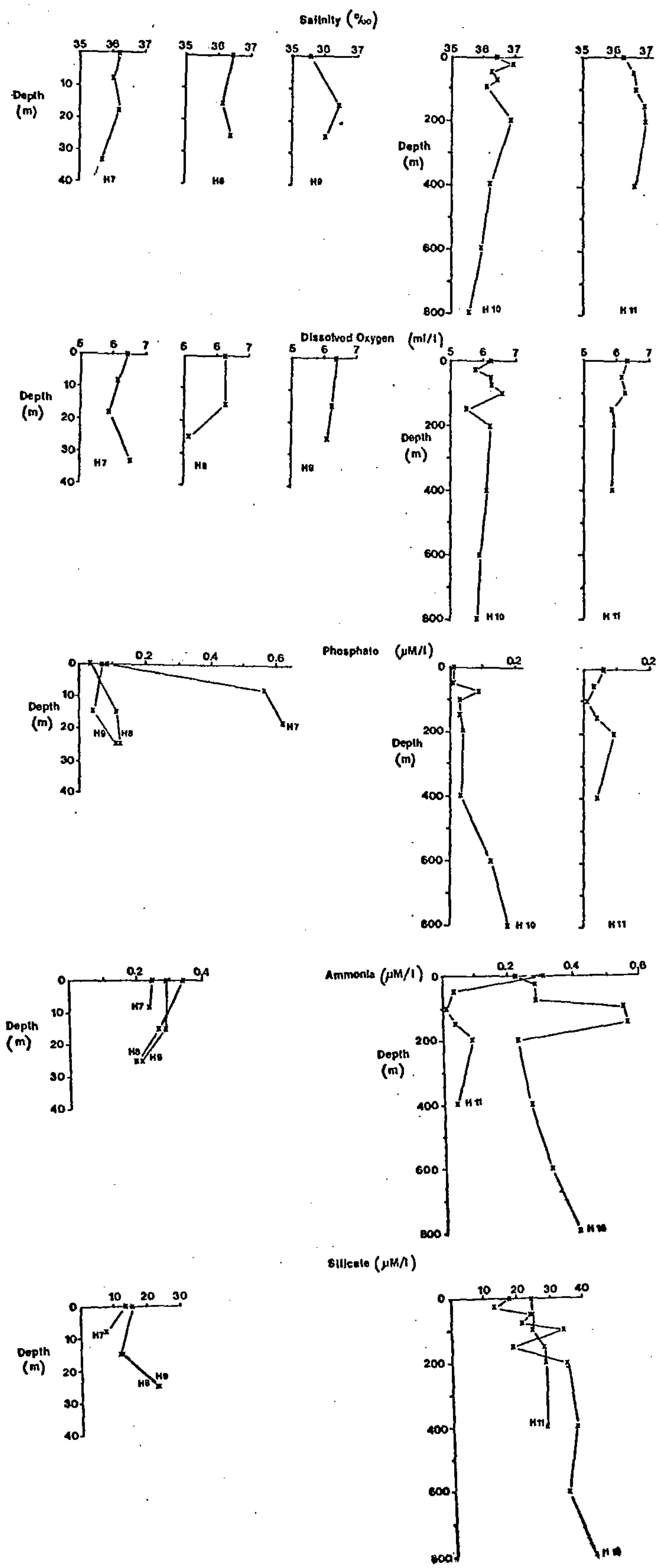
Water chemistry on Navidad Bank.

Barbara Campbell

ABSTRACT

Five hydrostations were carried out in the Navidad Bank area in an attempt to compare the environment on the bank with that of the surrounding waters. Temperature, salinity, oxygen, phosphate, ammonia and silicate were determined, and the data are reported in Appendix 2, and are shown in Figure 5. It was found that the water on the bank contains relatively high concentrations of nutrients. An increase in PO_4^{3-} content towards the bottom suggested possible release from the bank sediments. These studies indicate that the waters on Navidad Bank are capable of supporting high productivity.

Fig.5 Chemical analyses of stations in the vicinity of Navidad Bank.



3. Biological studies.

Biomass Determination, By Oxidation of Particulate Organic Carbon, On Navidad Bank

Peter Stein

ABSTRACT

Biomass was determined, by wet oxidation of particulate organic carbon, at three stations on Navidad Bank. Results show a relatively high biomass compared with that of the surrounding waters. Values were as high as 205 mg C/m^3. This is in agreement with the high concentrations of nutrients found in the water column, and suggests that this shallow area is highly productive.

Analysis of Biomass by Volumn Displacement

Caroline Woodwell

ABSTRACT

Biomass of water both on and off Navidad Bank was measured by a volume displacement technique.

The number of species and the species diversity index of samples on and off the Bank indicated that the waters on the Bank support a biomass. The settled volume of OM was twice as great and the diversity index was 1-6 points highter in the sample from the Bank. This is in agreement with the higher biomass determined by the wet oxidation procedure.

Light penetration in the waters on Navidad Bank

David Neary

ABSTRACT

Light intensity measurements were taken at four stations on and around Navidad Bank, and compared with data obtained from the Sargasso Sea. These showed that there was much greater attenuation of light, even at shallow depths,than observed in the Sargasso Sea, with continuously low values throughout the water column. This supports the observation that the waters on Navidad Bank are more productive than the Sargasso Sea.

4. Whale - related studies.

Whale sightings during W-44

Cynthia J. Malley

ABSTRACT

Near continuous daylight watches were maintained by at least two people in the foremast spreaders for cetacean sightings on, and in the vicinity of, Navidad Bank.

Approximately 90 sightings of humpback whales, *Magaptera novaeangliae*, were recorded. Even though Navidad Bank is known to be a mating and calving ground, no calves were observed.

Quality of identification was reasonably good, although many of the sightings were too distant to enable detailed photographic and visual identification.

Summary of Whale Behavior Studies on W-44

David Isenberg, Haskins Laboratories, New Haven, Connecticut

What is it like to be a humpback whale? To work towards the answer to this question on W-44, we could not observe whales directly in their natural underwater habitat, but rather were forced to rely on inferences from data collected by two techniques that were available to us. These techniques were (1) observation of surface behavior, and (2) underwater acoustical monitoring.

The most systematically collected data on observatin of surface behavior were collected on 3/1/79 during a continuous transect of Navidad Bank from SW to NE. (The data were tabulated by a conservative criterion for distinguishing individual whales from multiple sightings of the same whale. Of the 31 individual whales sighted on this day, only one was definitely not on the bank; three others also might not have been on the bank.) The data, taken hour-by-hour, also indicate that the whales are not randomly distributed across the bank. This finding, if replicated, offers a powerful means to isolate specific physical and/or biological factors related to whale density from the general character of the Bank by looking for factors that show high correlations with whale density on the bank itself.

Underwater listening on W-44 yielded five tapes of 45 minutes or less apiece. The sounds on these tapes were made primarily by humpback whales; often by many whales at once, though occasionally a single whale was distinctly in the foreground. I am working on the assumption that the regular pattern of the humpback song functions as a "carrier-wave" for information-bearing variations in the microstructure of the song. Analysis of strings of individual units of sound that human listeners would classify as repetitions of the same sound nevertheless reveals much spectral variation. Temporal analysis of strings of these roughly homogeneous units shows precise and regular patterning. Much more spectral and temporal analysis is needed before we can decide whether these variations are potentially information-bearing for whales, or, alternatively, if they simply reflect the finer details of organization of the humpback whale song.

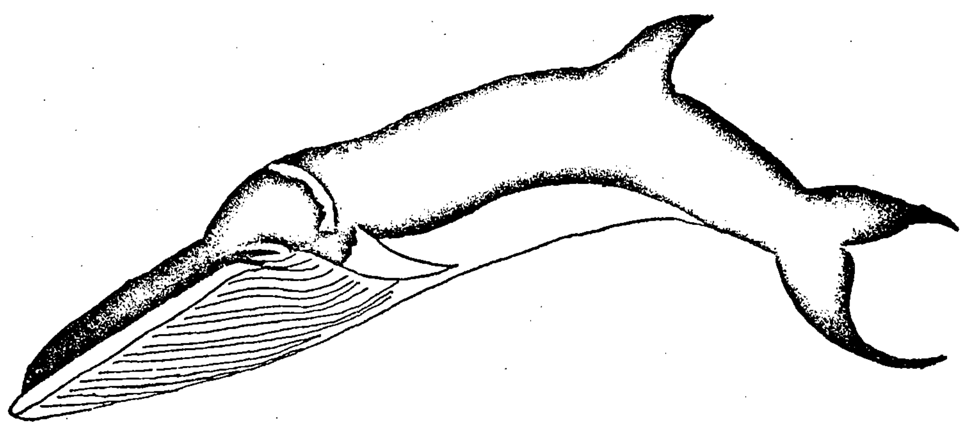
Structure and variation of the song of the humpback whale, *Megaptera novaeangliae*, on Navidad Bank

G. Scott Gazelle

ABSTRACT

Five forty-five minute recordings of humpback whale noises were obtained between 3/1/79 and 3/4/79 on Navidad Bank. The vocalizations occurred in a definite, repetitive cycle lasting approximately 18 minutes. This pattern was found to be fairly consistent throughout the course of a single recording, and among different recordings, and is termed a song. It was found to consist of five themes repeated in a never-changing order. Each theme consists of an unbroken sequence of a group of tone units

known as a phrase. While the sequence of themes was never observed to vary, and no theme was ever omitted from the pattern, the length of the song did vary. This variation was equally great within a single tape (presumably one whale) as it was among different tapes made at different times and locations, and was due to variation in the number of phrase repetitions withing the themes. A slight variation in tone, not noticed during any one recording, was evident when different recordings were analyzed.



MINKE WHALE

SHORE - BASED STUDIES.

1. Sosua, Dominican Republic.

A two-day research project was carried out on Sosua Beach, about 15km. east of Puerto Plata, in order to study the inteactions between the biological, physical and chemical environments.

This beach had been deposited in a sheltered bay, bounded on either side by gray, coralline cliffs between 3-8m. high. Two coral reefs were present in the bay. The inner one, which was approximately 50m. off shore, stretched across the bay with a narrow channel through the center. The outer reef was joined by the two headlands at the entrance to the bay, and was associated with a steep seaward slope.

Surveys of the beach revealed a high energy system with well-developed cusps. These were spaced at about 20-30m. intervals, with a maximum difference in elevation between crest and trough of up to 1.5m. Sediment grain size distribution was determined on samples taken along the beach. 91-97% of the sand had a diameter of 2 - 0.25mm. and 98% was greater than 0.25mm. The calcium carbonate content of these samples was analyzed in order to determine the relative importance of the coral reefs and the igneous basement rock of the island as the source of sand. The maximum $CaCO_3$ content determined was 12% by weight, suggesting that the reefs are not the major source of sand for Sosua Beach. Petrographical observations of this sediment revealed a high percentage of quartz grains, a somewhat surprising result which suggests that the beach may in fact be artificial in its origin, at least in part.

Biological studies were carried out on inter-tidal rocks and on coral reefs, and surveys of shells (Table 8), invertebrates (Table 9), seaweed (Table 10), and fish (Table 11) were completed.

2. Georgetown, Grand Cayman.

Ecological studies were carried out on a coral reef just off the entrance to Georgetown harbor. Zonations of species of coral were recorded and correlated with environmental conditions, e.g. windward or leeward side, etc. In addition, a record of fish species was kept, and is reported in Table 11. Territorial behavior studies of fish were also completed. Shells found in different habitats are recorded in Table 8.

Territorial behavior of coral reef fishes

Nadim Saleeby

ABSTRACT

The territorial behavior of fishes on a shallow coral reef off Georgetown, Grand Cayman, was studied using a baited fish trap. The blue head wrasses and hermaphrodites were found to be true wanderers, and were opportunistic and aggressive in their pursuit of food and their acquisition of new territory.

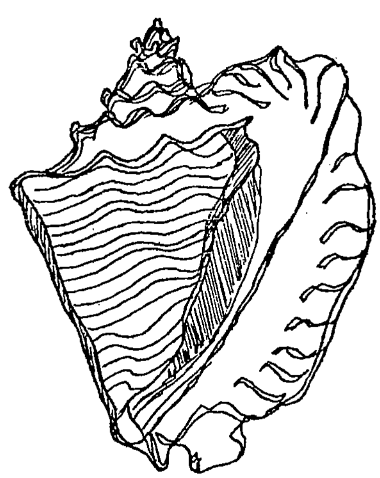


Table 8. SHELL LOG

Cynthia Johnson W-44

#	NAME	LOCALITY	TYPE OF HABITAT
1	Acmaea pustulata	Sosua Beach, D.R.	intertidal/coral rocks
2	Arca zebra	Grand Cayman, B.W.I.	shallow water; sandy
3	Arcopsis adamsi	Grand Cayman, B.W.I.	shallow water; muddy
4	Astraca phoebia	Grand Cayman, B.W.I.	shallow water
5	Astraea (sp?)	Grand Cayman, B.W.I.	shallow water
6	Batillaria minimia	Grand Cayman, B.WI.	intertidal; sandy
7	Chiton tuberculatus	Sosua Beach, D.R.	intertidal rocks
		Grand Cayman, B.W.I.	harbor rocks
8	Cittarium pica	Grand Cayman, B.W.I.	intertidal rocks
9	Columbella mercatoria	Grand Cayman, B.W.I.	shallow water
10	Conus f.floridensis	Grand Cayman, B.W.I.	shallow water; sandy
11	Cyphoma gibbosum	Grand Cayman, B.W.I.	shallow water; reef
12	Cypraea zebra	Puerto Plata, D.R.	shallow water
13	Diodora dysoni	Sosua Beach, D.R.	rocky shore
14	Diodora listeri	Grand Cayman, B.W.I.	rocky shore/sandy beach
15	Dosinia elegans	Grand Cayman, B.W.I.	sandy bottom
16	Emarginula purnila	Grand Cayman, B.W.I.	rocky shore/sandy beach
17	Lucapinella limatula	Grand Cayman, B.W.I.	coral reef
18	Mangelia plicosa	Grand Cayman, B.W.I.	sandy beach
19	Murex fulvescens	Sosua Beach, D.R.	coral reef
20	Nerita peloronta	Sosua Beach, D.R.	intertidal rocks
21	Nerita tessellata	Sosua Beach, D.R.	intertidal rocks
22	Nodolittorina tuberculata	Sosua Beach, DR.	intertidal rocks
23	Sanguinolaria sanguinolenta	Grand Cayman, B.W.I.	muddy; mangroves
24	Strombus gigas	Grand Cayman, B.W.I.	sandy; eel grass, coral
25	Tectarius muricatus	Grand Cayman, B.W.I.	intertidal rocks
26	Tellina lineata	Sosua Beach, D.R.	intertidal; sandy
27	Trivia suffusa	Grand Cayman, B.WI.	shallow water

Table 9 Invertebrates -- Sosua Beach

Diadema	Black Sea Urchin
Diodora	Limpet
Chiton	
Eusmilia fastigiata	Flower coral
Diplora labyrinthi formis	brain coral
Acropora plamata	elkhorn coral
Acropora cervicornis	staghorn coral
Gorgonia sp.	soft coral
Montastrea sp.	star coral
Tellin sp.	
Lucine sp.	
Nerita sp.	

Table 10 Seaweeds -- Sosua Beach

Penicillus sp.
Acetabularia sp.
Caulerpa sp.
Thalassia testudinum
Sargassum sp.
Padina sp.
Halimeda sp.
Enteromorpha sp.

Table 11

Species of fish collected during shore-based studies

Robert Nawojchik

Sosua Beach Reef

Scientific Name	Common Name
Aulostomus maculatus	trumpetfish
Holacanthus tricolor	rock beauty
Centropyge argi	cherubfish
Chaetodon capistratus	foureye butterflyfish
Abudefduf saxatilis	sergeant major
Chromis cyaneus	blue chromis
Microspathodon chrysurus	yellowtail damselfish
Eupomacentrus dorsopunicans	dusky damselfish
Thalassoma bifasciatum	bluehead
Halichoeres bivattatus	slippery dick
Acanthurus bahianus	ocean surgeon
Acanthurus chirurgus	doctorfish
Acanthurus coeruleus	blue tang
Lactophrys triqueter	smooth trunkfish
Hemiemblemaria simulus	wrasse blenny
Gobiosoma evelynae	sharknose goby
Gobiosoma genie	cleaning goby
Haemulon sciurus	bluestriped grunt
Elagatis bipinnulatus	rainbow runner
Eupomacentrus partitus	bicolor damselfish
Sparisoma viride	stoplight parrotfish
Sparisoma aurofrenatum	redband parrotfish

Species of fish collected during shore-based studies (cont.)

Georgetown Harbor Reef

Tylosurus crocodilus	houndfish
Holocentrus rufus	squirrelfish
Sphyraena barracuda	great barracuda
Gramma loreto	fairy basslet
Holacanthus tricolor	rock beauty
Chaetodon capistratus	foureye butterflyfish
Chaetodon striatus	banded butterflyfish
Chromis cyaneus	blue chromis
Abudefduf saxatilis	sergeant major
Microspathodon chrysurus	yellowtail damselfish
Thalassoma bifasciatum	bluehead
Halichoeres poeyi	blackear wrasse
Sparisoma viride	stoplight parrotfish
Acanthurus coeruleus	blue tang
Melichthys niger	black durgon
Alutera scripta	scrawled filefish
Lactophrys triqueter	smooth trunkfish
Enchelycore nigricans	viper moray
Pomacentrus partitus	bicolor damselfish
Opistognathus aurifrons	yellowhead jawfish

PELAGIC FISH STUDIES.

1. Pelagic fish survey.

Robert Nawojchik.

ABSTRACT.

Fish comprise the most successful vertebrate group in the marine environment. Surveys of fish not only indicate their distribution, but can also provide information concerning the evolutionary relationships of the various groups.

Pelagic fish species were collected by five techniques: fishing lines, dip nets, neuston tows, Isaacs Kidd Mid-Water trawl, and long line, and are listed in Table 12.

Table 12. Pelagic Species

S = Sargassum associated
M = many
C = captured
O = observed
No. = number captured

Date	Scientific Name	Common Name	No.
2/09	Histrio histrio (C)	Sargassum fish (S)	3
2/09	Kyphosus sectatrix (C)	Bermuda chub (S)	1
2/13	Coryphaena hippurus (C,O)	Common dolphisfish	2
2/15	Strongylura timucu (C,O)	Timucu needlefish	1
2/16	Seriola rivoliana (C)	Almaco jack	1
2/17	Carcharhinus falciformis (C)	Silky shark	1
2/17	Xanthichthys ringens (C)	Sargassum trigger-fish (S)	1
2/21	Coryphaena hippurus (C,O)		3
2/21	Elagatis bipinnulatus (C)	Rainbow runner	2
2/21	Canthidermis sufflamen (C,O)	Ocean triggerfish	1
2/21	Hirundichthys affinis (C,O)	Fourwing flyingfish	1
3/03	Carcharhinus plumbeus (C)	Sandbar shark	1
3/04	Nomeus gronovii (C)	Man-of-war fish (S)	1
3/05	Diaphus sp. (C)	Lanternfish	M
3/07	Hemirhamphidae (C)	Halfbeak	1
3/08	Diodontidae (C)	Porcupinefish	M
3/08	Belonidae (C)	Needlefish	1
3/08	Balistidae (C)	Triggerfish	1
3/13	Coryphaenidae hippurus (C)		1
3/15	Cyclothone sp. (C)	Bristlemouth	M
3/15	Sternoptyx sp. (C)	Hatchetfish	M

2. Studies on the dolphin fish - *Coryphaena hippurus*.

The dolphin fish, *Coryphaena hippurus*, is one of the swiftest of fishes and is ubiquitous in tropical and subtropical seas. It is brightly colored, its sides being vivid blue, and its tail largely golden yellow. It differs from related fishes in that its long tapering body is most massive close behind the head, and its dorsal fin extends back nearly to the base of its tail fin.

Stomach content analysis of some pelagic fishes.

Robert Nawojchik.

ABSTRACT

The stomach contents of three species of fish -- *Coryphaena hippurus*, the common dolphin fish, *Elagatis bipinnulatus*, the rainbow runner, and *Seriola rivolianna*, the Almaco jack -- were investigated, with emphasis being placed on *Coryphaena*. There seemed to be no relation between body weight, standard length, and stomach contents (either weight or constituents). Out of six *Coryphaena* stomachs analyzed, five contained predominantly fish remains, with any other material being unidentified. The other *Corphaena* stomach was empty except for eighty-eight nematode parasites. *Seriola* had an empty stomach, while in *Elagatis*, the bait used in capture dominated the stomach contents. The great majority of prey species were Exocoetids, with Balistids being the only other positively identified prey.

Fish Osteology.

Robert Nawojchik.

ABSTRACT

The comparative osteology of the skulls of three species of fish (Coryphaena hippurus, Elagatis bipinnulatus, and Seriola rivolianna) was studied. The two carangids (Elagatis and Seriola) were more closely related to each other in skull morphology than either was to the coryphaenid. The main distinguishing characteristc of Coryphaena's cranium was its large supraoccipital. However, similarities among all three were also evident, since all three are perciform fishes.

A survey of the parasites of dolphin fish.

Dell Hendon

ABSTRACT

A total of 142 parasites were extracted from the gills, gut and buccal cavity of five dolphin fish (Coryphaena hippurus). Most of the parasites belonged to the class Nematoda, with some Crustacea also present. This is in contrast with previous work which has generally identified Crustacea and Trematodes (Burnett-Herkes, 1974). No relationship was found between the number of parasites and the weight or length of the fish.

PLANKTON STUDIES

Distribution and abundance of pteropods in the Sargasso and Caribbean Seas

Cindy Johnson

ABSTRACT

The abundance and species diversity of pteropods were investigated at four different locations in the Western Atlantic Ocean and the Caribbean Sea.

Pteropods were most abundant in the Yucatan Straits and near Grand Cayman, probably due to favorable physical conditions. Navidad Bank was next in abundance, although species diversity was low. The lowest abundance of pteropods was found in the Sargasso Sea, which is presumably due to the low productivity of the area.

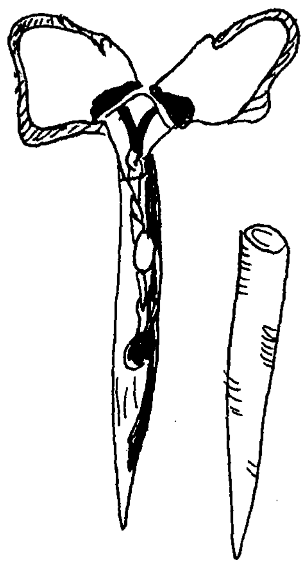
Eight different species were identified: *Hyalocyclis striatu* showed the greatest overall abundance, while *Cuvierina columella* was found in only one sample from the Yucatan Straits.

Diatoms in the Sargasso and Caribbean Seas

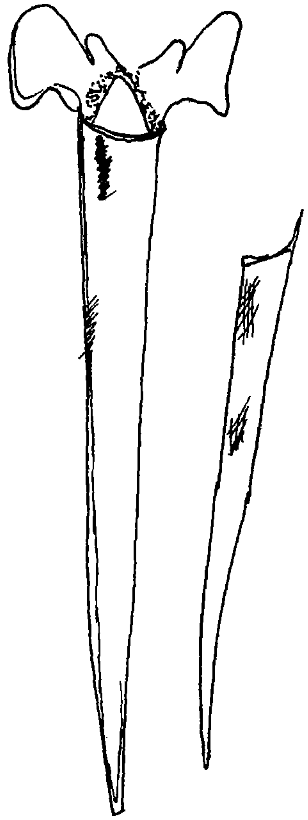
Katie Beal

ABSTRACT

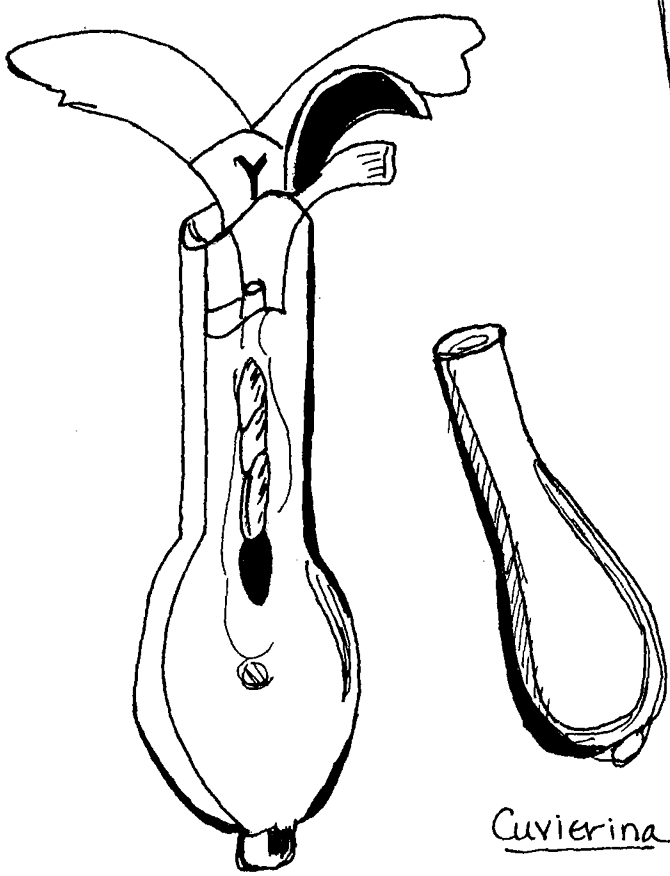
The purpose of this project was to study the distribution of diatoms in the Sargasso and Caribbean Seas. Samples were collected using a phytoplankton net, and were then dyed with Bengal Red and preserved with formalin. *Rhizosolenia setigera*, *Chaetaoceros lorenzianus*, and *Actinoptychus undulatus* were identified in a tow from the Sargasso Sea. No diatoms were observed in tows in the Caribbean Sea.



Creseis virgula



Hyalocyclis striata



Cuvierina columnella

A comparison of the morphological differences of a planktonic euphausiid and a mesopelagic decapod.

Nicky Hilmer

ABSTRACT

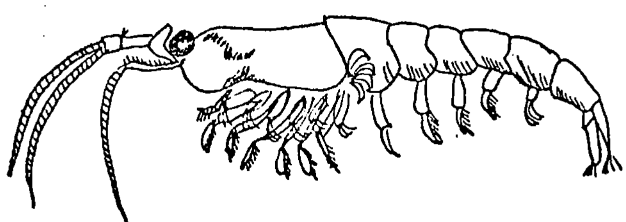
The external morphologies and characteristics of a surface-dwelling euphausiid, Euphausia hemigibba, and a mesopelagic decapod, Ancanthephyra brevirostris, were compared. Special attention was paid to the differences in size, color and appendages. These attributes were interpreted as adaptive features for the species' particular habitat.

Diesel fuel and oxygen demand.

Stephanie Truesdale

ABSTRACT

The effect of diesel fuel on the oxygen demand of an unfiltered water sample was determined by adding known amounts of diesel fuel to light and dark bottles. A correlation was found between the amounts of diesel fuel and the decreasing oxygen contents of the samples, suggesting that the diesel fuel had a detrimental effect on the plankton. This has implications for the marine food chain since phytoplankton constitute the lowest trophic level.



EUPHAUSID

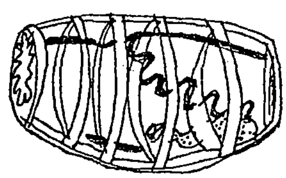
NUTRIENT REGENERATION STUDIES.

Nutrient regeneration in the genera Doliolum and Salpa.

Frederick Reis

ABSTRACT

The nutrient regeneration rates of urochordates of the genera Salpa and Doliolum were studied in order to investigate their possible dead-end position in the trophic web. Live specimens were collected in the Caribbean Sea, and placed in filtered seawater. Phosphorus and ammonia production, and oxygen consumption were then measured. The rates were determined to be 4.39×10^{-4} moles/ml displaced/min for phosphorus and 2.78×10^{-3} moles/ml displaced/min for ammonia production, and 1.11×10^{-4} moles/ml displaced/min for oxygen consumption. The internal concentrations of phosphorus and ammonia within the salps were 0.071 moles/ml displaced and 0.886 moles/ml displaced respectively. It seemsimprobable that salps and doliolids occupy a dead-end position in the trophic web, but may be important in the regeneration of nutrients.



Nutrient regeneration and vertical migration.

Susan Strater

ABSTRACT

The nutrient regeneration of zooplankton was studied in order to determine if there was a diurnal pattern associated with vertical migration. Live copepods were collected and placed in filtered water. The water was later analyzed for reactive phosphorus. The results obtained did not allow the original hypothesis to be proved or disproved.

IMMUNOLOGY EXPERIMENTS.

The Echinodermata, particularly the class Asteroidea, has been recognized as having a simple immune response system which to some extent resembles that of vertebrates. Hence, the studies of immune responses of Asteroidea is of direct relevance to immunological research in higher life forms.

The following projects are based on studies carried out by Dr. C. Reinisch investigating the immune response system in recognizing and phagocytizing foreign cells in the common sea star.

Recognition of amoebocytes of neighboring sea stars by the immune system of the sea star Oreaster reticulatus

Patrick Bartnett

ABSTRACT

An investigation was undertaken to determine the ability of the immune system of the cushion star, *Oreaster reticulatus*, to recognize as foreign the amoebocytes of neighboring stars of the same species. Amoebocytes of one Oreaster were removed from its coelomic cavity and injected into the coelomic cavities of three stars collected from the same general area. Another Oreaster received an injection of EGTA, used in obtaining coelomic fluid from the stars,without any amoebocytes, as a control. As a contrast this star later received an injection of amoebocytes from a comet star (*Linkia guildingii*). At intervals of ten minutes over one hour , cells were removed from the coelomic cavity and counted. Two of the stars recognized the neighboring star's cells as foreign, while the other showed little response. The star injected with comet star cells showed a much more notable immune response.

<u>Immunological Response in Oreaster reticulatus</u>

Jeff Hoadley

ABSTRACT

Four specimens of *Oreaster reticulatus* (Caribbean Sea Star) were injected with *Lytechinus variegatus* (Caribbean Sea Urchin) and human blood cells in order to determine the immunological reaction. The recognition of the introduced foreign cells promoted a clumping response facilitating the destruction of the sea urchin and human red blood cells. This indicates that the non-self recognition by self, which is present in vertebrate phyla, is also demonstrated by this invertebrate phyla.

METEOROLOGICAL STUDY.

Monitoring the pH of rainfall along the cruise track of R/V Westward

Lewis Gilbert

ABSTRACT

Many studies have recently been undertaken to determine the causes of acidity in rainfall, most of which have reflected the effects of urban and industrial pollution. Rainfall was samples along the cruise track of W-44 in an attempt to collect data in an environment relatively free from these effects. Five samples were collected, and a correlation was found between pH and proximity to land masses. Phosphate concentrations of the rain were below detection limits.

METHODOLOGY

Color film development at sea.

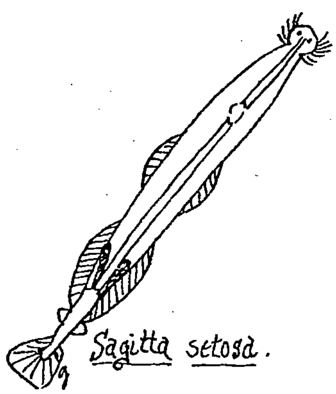
Frederick Reis.

Aboard the Westward it is possible, with great success, to develop and mount color slides from Ektachrome film. This is accomplished using the Unicolor E-6 developing kit. Film is loaded into the processing tank in total darkness; from then on the processing can be done at any light intensity. Chemical are mixed on board using ship's tap water and are good for four rolls of 36-exposure slide film.

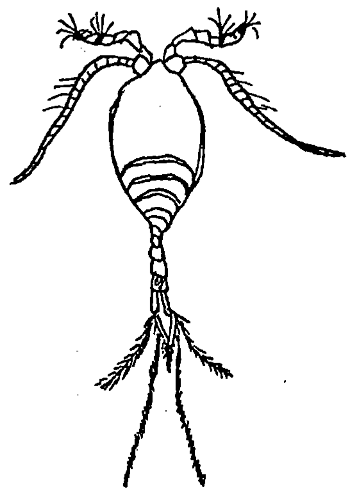
Temperature and timing are variables needing great accuracy, but this can be accomplished using a stopwatch and large camper coolers to keep both the chemicals and the rinse water at the correct temperatures throughout the whole process, which takes about one hour. The film is then dried and cut into frames, and then mounted into heat-sealed Kodak ready-mounts, which are heated on the galley stove.

Underwater photographs of coral reefs,sightings of marine mammals, and shipboard activities, such as longlining and coring,could be observed at evening in deck slide shows.

APPENDICES



Sagitta setosa.



APPENDIX 1a

EXAM

Answer any 3 questions.

1) While in the Caribbean, you see the following 3 whales. From the descriptions given, identify the kind of whale, and state what additional characteristics you would look for:

   a) blow: low and bushy
      fin: small dorsal fin, slightly hooked
      flipper: extremely long, mostly white

   b) color: all dark
      shape: very stout and round; arched mouth; white callosities on head
      fin: none

   c) body: head very V-shaped
      diving: does not arch back or raise flukes
      color: white band on flippers

2) We have sampled, or discussed, four biological environments:

   (i) rocky, inter-tidal environment
   (ii) mesopelagic environment
   (iii) benthic environment in the deep ocean
   (iv) benthic environment in shallow water

   For 2 of these, discuss the adaptations of marine organisms and/or plants which enable them to live in these regions.

3) You are a Marine Scientist involved in a project to isolate an area for disposal of chemical wastes to be dumped on the ocean floor. An area has been suggested, and you are responsible for assessing its suitability in terms of possible contamination of the environment. What parameters would you measure, why, and how?

EXAM (cont.)

4) Discuss the adaptations marine mammals have evolved to cope with anoxia. Include 2 anatomical adaptations and the "diving reflex".

5) Discuss aspects of the geology of the Caribbean, and how these are related to larger scale geological phenomena, with particular reference to the islands visited.

6) Before this cruise many of your impressions of the deep ocean have probably been fashioned by the mass media. Imagine you now have the opportunity to make a film that is designed to characterize particular aspects of the ocean and marine life, and to convey your impressions of the ocean as you have experienced it on this cruise. Describe what you would incorporate into this film, and how you would justify the continuation of different types of marine scientific research.

APPENDIX 1B

Marine Fauna and Flora used as a basis for practical exam.

Phylum Arthropoda	
Panulirus larva	Spiny lobster larva
Halobates micans	Water strider
Nematoscelis tenella,	
N. microps	Assorted Euphausiids
Subclass Copepoda	Copepod
Phylum Chaetognatha	
Sagitta elegans	Arrow worm
Phylum chordata	
Anguilla murexidae	Eel larva
Cypselurus heterurus	Flying fish
Thaliacea democratina	Salp
Balaenoptera acutorostrata	Minke whale
Phylum Chlorophyta	
Acetabularia crenulatum	Benthic green algae
Phylum Cyanophyta	
Trichodesmium sp.	Blue-green algae
Phylum Cnidaria	
Diploria labyrinthiformis	Coral
Phylum Echinodermata	
Tripneuesta ventricostus	Sea urchin
Linckia guildingii	Common comet star
Class Holothuroidea	Sea cucumber

Marine Fauna and Flora used as a basis for practical exam (cont.)

Phylum Mollusca	
Carolinia gibbosa	Shelled pteropod
Chiton tuberculata	Chiton
Phylum Nematoda	Round worm
Division Phaeocophycophyta	
Sargassum *fluitans/natans*	Sargassum Gulfweed
Phylum Protozoa	
Homotrema rubum	Foraminifera

APPENDIX 2.

Results of chemical analyses of water samples from the Sargasso Sea and Navidad Bank.

a) Sargasso Sea.

Station #	Position	Depth (m)	Salinity ($^{o}/oo$)	Oxygen (ml/l)	Ammonia (μM/l)	Phosphate (μM/l)
W-44 H3	25° 00'N	0	----	6.03	1.00	----
	70° 15'W	50	36.34	6.08	----	0.37
		100	35.50	6.26	1.53	0.39
		125	35.09	6.10	0.82	----
		150	35.00	6.10	0.60	0.30
		200	35.06	----	1.18	0.26
		250	36.57	5.88	1.04	----
		500	35.23	5.22	1.53	----
		1000	34.01	6.95	1.10	----
		1500	33.97	7.33	2.11	----
		2000	34.01	7.59	0.78	----
W-44 H1	23° 35'N	0	36.41	5.84	2.71	0.26
	70° 50'W	50	36.26	5.79	----	----
		100	36.26	5.80	----	0.24
		150	36.28	5.46	2.26	----
W-44 H2	23° 30'N	0	37.05	6.03	1.68	0.37
	70° 30'W	50	36.17	5.99	----	0.40
		100	35.46	5.88	----	0.29
		125	36.33	5.92	1.39	----
		150	35.96	5.96	----	0.28
		250	36.68	5.73	1.27	0.23
		500	36.28	---	3.61	0.24
		750	35.87	6.02	3.95	0.32
		1000	----	6.46	2.31	0.27
		1500	34.43	7.10	1.58	0.51
		2000	35.11	6.06	1.47	0.84

Station #	Position	Depth (m)	Salinity ($^{o}/oo$)	Oxygen (ml/1)	Ammonia (µM/1)	Phosphate (µM/1)
W-44 H4	22° 32'N	0	36.87	5.96	0.94	0.55
	70° 08'W	50	37.28	6.03	0.87	0.51
		100	36.13	6.03	0.55	0.48
		125	35.47	5.80	0.42	----
		150	36.05	5.88	0.55	0.51
		200	36.50	5.73	1.08	0.50
		500	36.85	5.73	0.45	0.52
		1000	37.27	6.10	----	----
		1500	35.26	4.35	3.46	0.61
W-44 H6	21° 47'N	0	36.19	6.18	----	----
	71° 19'W	50	35.98	611	1.00	0.38
		75	36.60	6.11	1.37	----
		100	37.42	6.10	1.69	0.35
		150	37.83	---	----	----
		200	34.99	5.65	0.70	0.32
		250	36.97	5.65	1.03	0.32
		300	36.42	5.77	1.29	0.46
		350	----	5.73	----	0.45
		400	36.78	5.89	2.14	0.36
		450	36.28	5.79	1.84	----
		500	36.60	596	1.16	0.37
W-44 H5	21° 38'N	0	36.64	6.11	0.53	0.50
	71° 30'W	50	36.27	6.26	0.41	----
		75	36.64	6.47	0.36	0.51
		100	36.91	6.80	0.26	0.50
		150	37.01	6.38	0.62	0.54
		200	36.87	----	0.63	----
		250	----	5.73	0.69	0.50
		500	36.40	5.89	0.53	0.79
		1000	----	----	0.32	1.53
		1500	36.60	6.11	----	----

b) Navidad Bank.

Station #	Position	Depth (m)	Salinity (°/oo)	Oxygen (ml/l)	Ammonia (uM/l)	Phosphate (uM/l)	Silicate (uM/l)
W-44 H7	19° 57'N	0	36.19	6.41	0.25	0.08	13.94
	68° 46'W	8	36.05	6.18	0.24	0.56	7.45
		18	36.23	5.85	----	0.62	----
		33	35.69	6.57	----	----	----
W-44 H8	20° 03'N	0	36.46	6.23	0.34	0.03	15.54
	68° 52'W	15	36.14	6.28	0.27	0.11	11.78
		25	36.37	5.19	0.20	0.12	22.42
W-44 H9	20°01'N	0	35.55	6.38	0.29	0.07	----
	68°55'W	15	36.46	6.26	0.29	0.03	11.97
		25	36.05	6.11	0.22	0.11	22.42
W-44 H10	20° 07'N	0	36.46	6.28	0.22	0.01	18.92
	68° 59'W	25	36.92	5.73	0.28	----	13.37
		50	36.28	6.26	----	0.01	24.14
		75	36.42	6.28	0.28	0.09	21.21
		100	36.10	6.61	0.55	0.03	34.32
		150	----	5.49	0.56	0.03	18.41
		200	36.92	6.28	0.23	0.04	35.45
		400	36.23	6.14	0.27	0.04	37.65
		600	36.05	5.91	0.32	0.13	34.96
		800	35.64	5.86	0.41	0.18	42.73
W-44 H11	20° 01'N	0	36.28	6.35	0.31	0.06	24.71
	68° 43'W	50	36.55	6.14	0.21	0.03	24.97
		100	36.64	6.28	0.19	0.01	24.71
		150	36.92	5.85	0.16	0.04	28.15
		200	36.94	5.91	0.16	0.09	28.51
		400	36.59	5.86	0.15	0.04	28.34

APPENDIX 3

Scientific operations on W-44 involving general science watch participations

Operation	Numbers performed or deployed
Bathythermograph	37
Zooplankton tows	35
Meter net	10
Neuston net	25
Phytoplankton tows	13
Isaacs kidd midwater trawl	1
Longline	1
Hydrocasts	11
Sediment grabs	3
Gravity corer stations	2
Photometer stations	10
Acoustic stations	14
Cetacean watch	140 hours (minimum)
NOAA weather observations	49