Cruise Report

W-42 (BLAST)*

Woods Hole - St. Thomas

October 11 - November 22, 1978

R/V Westward

Sea Education Association

Woods Hole, Massachusetts

SHIPBOARD DRAFT

* Bermuda St. Lucia Antigua St. Thomas

PREFACE

This report presents an outline of the scientific activities and observations conducted aboard the R/V Westward during W-42. These activities fall into two categories: an academic program offered in more or less traditional format, but on board ship; and research and project work conducted on a more individual basis. Most of this report consists of abstracts from the students' Shipboard Reports which outline individual projects and give a first assessment of the results. The staff has also taken this opportunity to enlarge upon or interrelate aspects of our activities which may have seemed unclear during the cruise.

As we approach St. Thomas in this final stage of the cruise, I am more aware than ever of the patience, the persistence and the skill of an exceptional staff aboard Westward. I wish to express my especial gratitude to Ms. Abby Ames upon whom I have depended in all stages of the cruise and who is in charge of the shipboard laboratory. Her effectiveness under the difficult working conditions at sea derives from personal attributes quite apart from training and education.

Mr. Thomas Reidenbaugh, also among our full time staff, initiated and coordinated the surface truth program for SeaSat A and also had responsibility for the marine mammals program for W-42. I know the students join me in thanking Tom for his attentiveness to their needs and concerns. The crew of the yacht "Moonshadow" no doubt appreciate his visual acuity in spotting their distress flare.

The range of scientific expertise aboard ship was enlarged on W-42 by the participation of three visiting scholars. Dr. Tim Flynn (M.D.) of the University of Texas accompanied us for the open ocean leg from Woods Hole to Antigua. In addition to administering the occasional potion and suture he performed a number of most informative fish dissections.

Dr. Sally Hornor of Syracuse University supervised a program of benthic microbial studies on leg 2, and introduced this topic to our academic coverage. The aggressiveness with which Sally pursued her research set an example which undergraduate students seldom have an opportunity to witness, much less become personally involved with. My thanks to Sally for her participation and help and company aboard Westward.

Dr. Susan Humphris, from Lamont Doherty Geological Observatory, joined us for legs 2 and 3. Susan's many areas of contribution outside her own field of geochemistry have been notable for their breadth and depth of coverage. Her participation has been of equal value to the students and staff alike.

This report, composed at sea, reflects the inevitable limitations imposed by restricted time, library facilities and reflection. On the other hand, from the viewpoint that writing constitutes an essential stage of the thought process these limitations are for the moment of secondary concern.

Arthur G. Gaines, Jr.
Chief Scientist
November 21, 1978
South of St. Thomas, U.S.V.I.

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SUMMARY

This offering of Introduction to Marine Science Laboratory 1/ was structured about *Westward*'s transect of the Western North Atlantic Ocean and the Eastern Caribbean Sea. The course included 20 lectures, 150 contact hours of supervised field and laboratory work and an individual project for each student. The content of the course is a reflection of the opportunities inherent to the ship's track as well as the special skills and interests of the staff; on W-42 we were able to include aspects of all the major disciplines of oceanography.

On leg 1 (punctuated by a force 10 gale and an unscheduled stop at Bermuda for medical precautions) programs were initiated in satellite surface truth, neuston analysis, NOAA weather observations and observations on marine mammals and birds. Northeast of Antigua, our first scheduled port, 24 hours were spent surveying for Echo Bank, an oceanic "shoal" of questionable existence which we, also, were unable to locate.

At Antigua, inshore waters were analysed to enlarge upon last year's preliminary work on the nature and origin of suspended particulate material. In addition, measurements of nutrient flux at the sediment-water interface were conducted.

During leg 2 a multidisciplinary survey of the Antigua-Barbuda Insular Platform was conducted, including attention to sediments, hydrography, currents, light penetration, chlorophyll and particulate carbon distribution, nutrient concentrations, plankton and large fish occurence.

Gravity cores taken west of Guadeloupe were examined for foraminifera and attempts were made to sample sediments near St. Pierre (Martinique) and Mt. Pelée, the volcano that destroyed that city. The distribution of marine mammals was investigated along the Leeward Islands and the passages and acoustic records were made of cetacean vocalizations. Coral reef studies, a study of territoriality of fishes, and a study assessing a method of fish population census, were carried out during a stop at the Tobago Cays. Other student work during the cruise dealt with the productivity of *Sargassum* weed, and with colonial radiolarians.

All processing of samples and data, including photographic records, was completed and discussed in written Shipboard Reports prior to our arrival at St. Thomas, the terminal port for W-42.

1/ Boston University, NS CLX 225

INTRODUCTION

Introduction to Marine Science Laboratory is one of two simultaneous offerings aboard Westward [1/] and is based in part upon a prerequisite course offered at Woods Hole, Massachusetts (Introduction to Marine Science) which also runs for six weeks. The shipboard marine science program on W-42 manifests the interests and skills of the staff and students and the opportunities for research and study inherent to the ship's track (Table 1 ; Fig. 1).

Research conducted during W-42 partly represents ongoing work of individuals and agencies that have extended their assistance to our students. Material reported here should not be cited or excerpted without written permission of the Chief Scientist.

Staff

The shipboard expertise in ocean sciences includes that of both the scientific staff who were trained largely at oceanographic institutions, and the nautical staff (Table 2) upon whom we were able to depend during W-42, in the areas of navigation, meteorology and fisheries among others.

1/ The other is Introduction to Nautical Science Laboratory.

Table 1 W-42 Itinerary

Leg	Depart	Date	Arrive	Date
1	Woods Hole, MA	10/11/78	Bermuda 1/ (St. George)	10/19/78
	Bermuda (St. George)	10/21/78	Antigua (English Harbor)W.I.	10/30/78
2	Antigua (English Harbor) W.I.	11/2/78	St. Lucia (Castries) W.I.	11/9/78
3	St. Lucia (Marigot Bay) W.I.	11/12/78	St. Vincent 2/ (Bequia) W.I.	11/14/78
	St. Vincent (Bequia) W.I.	11/15/78	St. Vincent (Tobago Cays) W.I.	11/15/78
	St. Vincent (Tobago Cays) W.I.	11/16/78	St. John 2/ (Cruz Bay) U.S.V.I.	11/21/78
	St. John (Christmas Cove) U.S.V.I.	11/22/78	St. Thomas U.S.V.I.	11/22/78

1/ Unscheduled

2/ Entering and clearing customs only

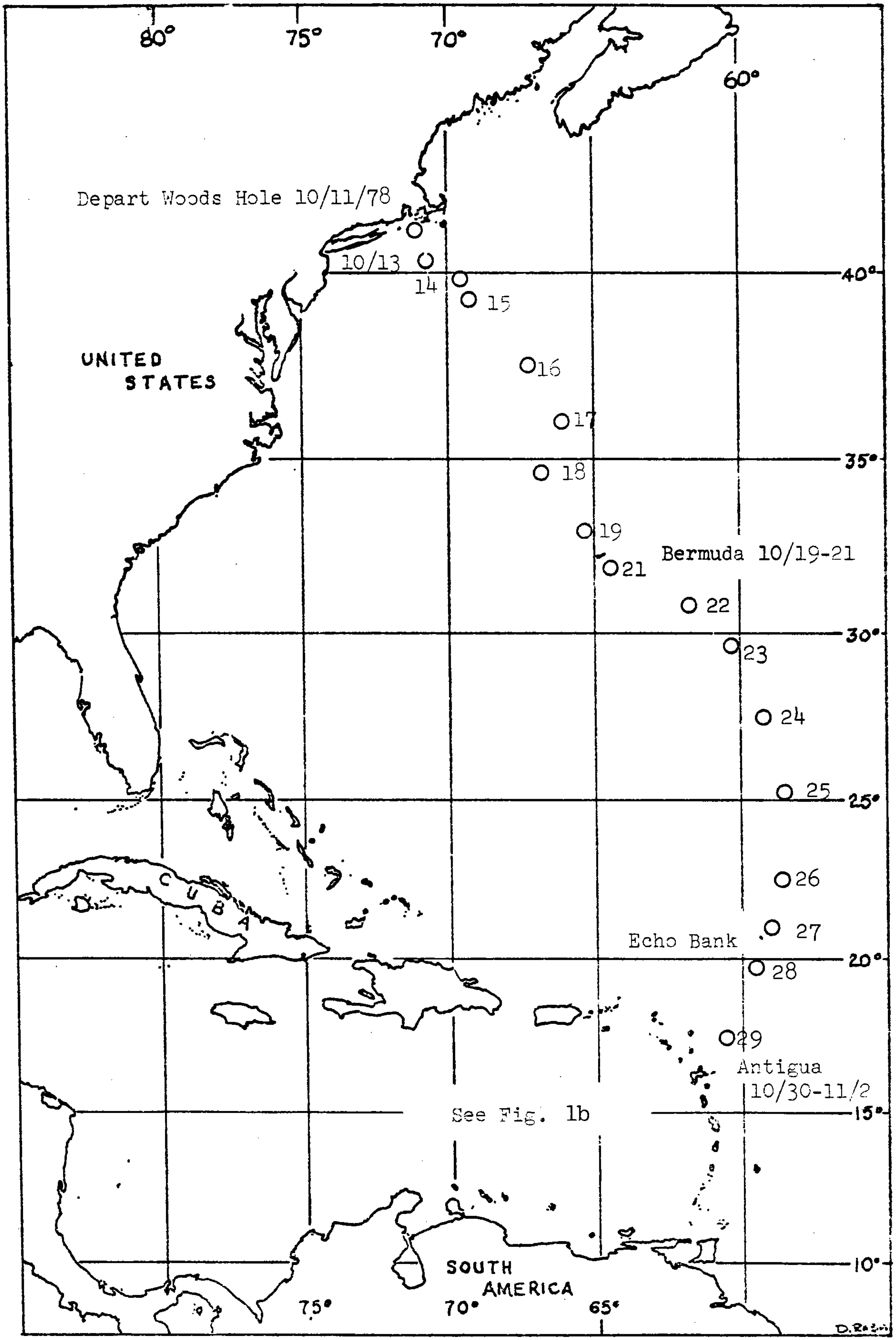


Fig. 1a W-42 Cruise track, western North Atlantic leg (see also Fig. 1b). Noon positions.

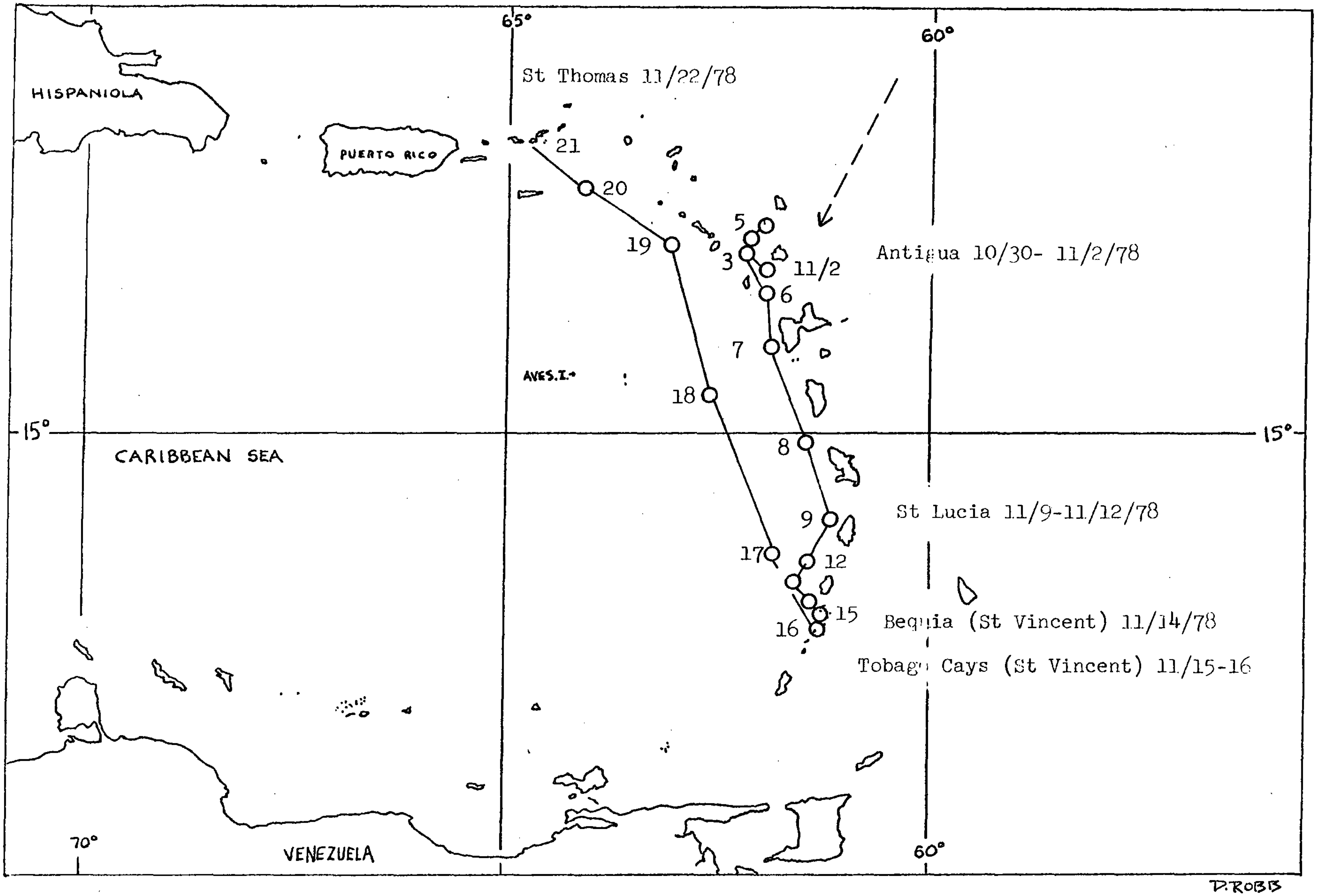


Fig. 1b Caribbean legs of W-42 cruise track. Noon positions.

Table 2 W-42 Ship's Complement

Nautical Staff

Richard W. Farrell, Jr., B.A., Ocean Operator	Captain
R. Kenneth Hamilton, B.A., Ocean Operator	Chief Mate
Donald M. Thomson, Jr., B.S., Chief Mate Oceans	Second Mate
Armin E. Elsaesser, III, B.A., Inland Operator	Third Mate
Edward J. Beckett, Licensed Engineer (legs 1&2)	Chief Engineer
Patrick J. Harren, M.S. Licensed Engineer (leg 3)	
Sally I. Kaul, B.S.	Steward

Scientific Staff

Melinda A. Ames, B.S.	Scientist-2
Arthur G. Gaines, Jr., Ph.D.	Chief Scientist
Thomas G. Reidenbaugh, M.S.	Scientist-3

Visiting Scientists

Timothy C. Flynn, M.D., Houston Medical Center (leg 1)	Ship's Doctor
Sally Hornor, Ph.D., Syracuse University (leg 2)	
Susan Humphris, Ph.D., Lamont Doherty Geological Observatory (legs 2 & 3)	

Students	College	Home
Kathryn A. Ashton	Brown University, RI	West Caldwell, NJ
Toby E. Claus	Connecticut College, CT	Kennebunkport, ME
Andrea L. D'Aquilla	St. Joseph College, CT	West Hartford, CT
Paul F. Detjen	Williams College, MA	St. Louis, MO
Susan C. Dierdorff	Tufts University, MA	Crownsville, MD
Nancy J. Dimmer *	U. Minnesota, MN	Minneapolis, MN
Barbara P. Haupt	Cornell University, NY	Overland Park, KS
Tamsen Hermann	Cornell University, NY	South Pomfret, VT
David G. Jenkins	Purdue University, IN	Lakewood, OH
Jeffrey P. Jenks	Williams College, MA	Toledo, OH
Diana L. McCargo	Hampshire College, MA	Sewickley, PA
Julie A. Miller	Univ. Virginia, VA	Barrington, RI
Lauren S. Mullineaux	Pomona College, CA	Lakewood, CO

* Disembarked at Bermuda

Students	College	Home
David W. Neiburg	Brandeis University, MA	Levittown, PA
Jeffrey A. Platt	Indiana University, IN	Fort Wayne, IN
James F. Snyder	Keene State College, NH	Elkins, NH
Carol C. Story	Connecticut College, CT	Framingham, MA
Cynthia A. Thomson	Mapconsnet Regional H.S. MA	Boxford, MA
Daniel F. Tierney	State Univ. N.Y. Albany, NY	Troy, NY
Mary Jo Wagner	Middlebury College, VT	Manchester, ME
Joanne Willey, R.N.	U. Penn., Phila., PA	Philadelphia, PA
Melonie Wilson	Colby College, ME	Easton, CT
Charles Zechel	Reed College, OR	Nashua, NH
Steven C. Zuckerman	Univ. New Hampshire, NH	Framingham, MA

ACADEMICS

Lectures

The schedule of lectures (Table 3) like the rest of the Marine Science program, reflects the ship's location and research activities. Evaluation in this area was by means of a written final examination (Appendix 1).

Science Watch

A scheduled 24-hour science watch consisting of a staff or visiting scientist and two or three students was maintained throughout the cruise.

Activities during watch involved execution of the scientific program (Table 4) and maintenance of a complete science log. Time on watch also assured the opportunity for personal instruction on any aspect of the cruise work and assistance in individual project work. Staff members were encouraged to conduct demonstrations or carry out exercises during watch time not otherwise committed.

A collection of organisms representing many phyla and ecological life types of marine organisms was assembled during the cruise and served as the basis for a practical examination included in the final exam (Appendix 2).

Individual Projects

Students were required to define an individual project while ashore at Woods Hole. Any topic is acceptable which a) takes advantage of a special opportunity afforded by the Westward cruise; and b) is conducted and presented in a scientific manner. The majority of projects selected are traditional problems in a natural science, but

Table 3 Seminar Schedule for W-42

October	12	Science Watch: standard activities; the log; protocol.	Gaines
	13	Remote sensing. Introduction.	Reidenbaugh
	16	Determination of salinity. Chlorinity.	Gaines
	20	The geology of Bermuda.[1/]	Markham
	23	Marine mammals. The great whales.	Reidenbaugh
	24	Oxygen determination: the Winkler method.	Ames
	25	Remote sensing. General applications and capabilities.	Reidenbaugh
	26	W-42 progress report.	Gaines
	27	The hydrocast.	Staff
	28	Fish anatomy. Dissection of *Coryphaena hippurus*.	Flynn
	31	Arawak Indians at Indian Creek, Antigua. [2/]	Nicholson
November	5	Nutrient cycling in sediments.	Hornor
	6	Colorimetric methods of nutrient analysis.	Gaines
	7	The geology of the Caribbean Sea.	Humphris
	8	The 1902 eruption of Mt. Pelée.	Zuckerman & staff
	11	Geology of the Soufriere region of St. Lucia.	Humphris
	13	Estuaries and coastal embayments.	Gaines
	14	SEASAT-A. Design capabilities and objectives.	Reidenbaugh
	15	Aspects of coral reef biology.	Ames
	17	Fish and fisheries.	Humphris, Gaines & Thomson

1/ Presented at the Bermuda Biological Station by Dr. John Markham.

2/ Presented at Antigua by Mr. Desmond Nicholson of the Antigua Archeological Society.

Table 4 Scientific Operations on W-42 Involving General Science Watch Participations

Operation	Numbers Performed or Deployed	
Bathythermographs	23	94
Zooplankton tows	37	
Bongo net	4	
Meter net	6	33
Neuston net	27	–
Phytoplankton tows	14	23
Hydrocasts	9	23
Chemical determinations		
Salinity titrations	330	295 [illegible]
Oxygen titrations	529	
Reactive phosphorus	115	
Silica	89	
Ammonia	86	
Oxidizable organic matter	23	
Chlorophyll	16	
Sediment grab samples	2	
Gravity corer stations	16	
Photometer stations	13	
Acoustic (hydrophone) stations	14	
Cetacean watch	ca. 130 hours	
Bathymetric profiling	ca. 308 miles	
Isaacs Kidd midwater trawl	1	5
Reef diving expeditions	6	
Longline	3	
NOAA Weather observations	57	

occasionally an applied or engineering project is chosen instead (see page 83). A complete written Shipboard Report is required of each student prior to leaving the ship.

These three areas -- lectures, science watch and individual projects -- are given equal emphasis in evaluation (although they do not occupy equal time allotments). Among them, the student's participation, level of initiative and responsibility, and his research orientation vary nearly from one extreme to the other.

SHORE VISITS AND FIELD TRIPS

During port stops optional visits were made to areas of interest. On W-42 these included:

- The Bermuda Biological Laboratory for Research
  Guided tour by Dr. John Markham and lecture on the geology of Bermuda (see p. 11).
- The Indian Creek Arawak Indian excavation
  Field trip to the excavation and visit to a museum containing relics taken therefrom, by Mr. Desmond Nicholson. Lecture on the excavation and the effects of sea level change on the geography of the Lesser Antilles and implications for early migration (see p. 12).
- The geology of the Soufrière region of St. Lucia
  Geological field trip guided by Dr. Susan Humphris to a region of Pleistocene vulcanism and of currently active hot springs (see p. 13).

The Bermudas

The Bermuda Islands lie on the SE edge of the Bermuda Seamount, a pedestal that rises 4000m from the seafloor. Carbonate rock which caps the surface 35 to 100m, and which forms the islands, is a product of Pleistocene and Recent deposition. Carbonates are underlain by a discontinuous deposit of pryoclastics and weathered volcanic material of Miocene age, which in turn are underlain by basalt lavas. These lavas are associated with at least two periods of activity, potassium argon dated at $34\text{–}50 \times 10^6$ yrs BP and $90\text{–}110 \times 10^6$ yrs BP, respectively. The earlier activity is associated with the formation of the Seamount at the Mid-Atlantic Ridge.

The Islands, composed of aeolean carbonate sandstone, consist of a series of onlapping large amplitude dune ridges. Four periods of aeolean deposition have been identified and of these at least three correspond in age with Pleistocene interglacials. A high stand of sea level is indicated by lateral gradation of these aeolean sands into marine deposits.

Between the aeolean episodes clays and atmospheric dust formed red soils similar in composition to the one presently accumulating.

"Reefs" occupying the Bermuda Platform are largely aeolean deposits thinly covered by modern calcareous organisms. Other prominent Platform features are fossil-vermetid worm reefs. Therefore, the living coral reefs of Bermuda are not coral reefs at all but ought to be regarded as features of a tropical rocky bottom community.

The Indian Creek Arawak Indian Site (Antigua)
(from lectures by Desmond Nicholson)

The Indian Creek Site was recognised archeologically in 1955 and systematically excavated in 1973 by Yale University under the auspices of the Antigua Archeological Society. These diggings provided a copious store of Arawak Indian artifacts -- largely shards of ceramics but also shaped bone, shell and stone implements, as well as refractory food relics. One pit exposes a complete human skeleton.

The site covers about 20 acres and is marked by a number of middens including a conspicuous semicircular one on its circumference. Though less evident through the vegetation of an unusually wet season, a profusion of conch and other shells were visible over the site in drier times.

The Arawaks evidently originiated culturally near Saladero Venezuela and began their expansion (or evacuation) northward ca 2000 BP. Their presence is well documented in the Lesser Antilles islands. At Indian Creek, charcoal has been ^{14}C dated at about 1600 BP through 1100 BP. Ceramic style and adornment at this site indicates cultural evolution in that interval and, later, the Ellenoid influence from the Greater Antilles to the north. The Arawaks were apparently exterminated by the warlike Caribes (who occupied the islands when the Spaniards arrived) sometime between 1200 AD and 1400 AD.

Some evidence exists elsewhere on Antigua of older, preceramic sites, although these have provided nowhere near the materials found at Indian Creek. It is known that man existed in Venezuela in association with Pleistocene fauna as early as 17,000 BP and in Hispaniola by 7,000 BP. With the expanded Caribbean island areas and emerged marine ridges resulting from glacial lowering of sea level, Lithic and Archaic peoples may have found seafaring in the area relatively safe. Mr. Desmond Nicholson has proposed that these early people were probably competent seafarers to the extent that they were able to voyage at will among the islands.

Field Trip to the Soufrière Volcanic Region, St. Lucia

Susan Humphris, Lamont

The Lesser Antilles represent an active island arc beneath which the oceanic plate to the east is being subducted. This results in a specific rock sequence - the "calc-alkaline" suite - which is typical of island arc volcanism.

During a port stop in St. Lucia, the opportunity was taken to visit a caldera and collect representative samples of this rock suite. The area visited was the Soufrière volcanic centre, which is a caldera of mid-Pleistocene age (about 40,000 yrs). Four main phases of volcanic events can be distinguished in the Soufrière region:

a) basaltic lava flows
b) growth of andesitic stratovolcanoes
c) violent emission of pryoclastics from an incipient caldera
d) eruption of andesite and dacite lavas from this caldera.

Samples from each of the major rock types were collected.

Volcanic eruptions in the island arc complex are characterised by highly explosive activity with emanations of considerable quantities of ash and pyroclastics. This has resulted in thick deposits of ash and agglomerates over much of the island, with lava flows constituting only a small proportion of the emissions. Spectacular features are provided by the late-stage dacite domes of Gros Piton and Petit Piton, which rise 2550' above sea level.

A visit was also made to Sulphur Springs, where emission of steam, hydrogen sulphide and other gases provide evidence of present-day activity. In many of the pools, steam blasts through the water giving the impression of boiling, and producing fountains 3-4' high. Crystalline sulphur, copper and iron minerals, gypsum and quartz are among the minerals currently being deposited. These springs provide one of the most impressive examples of solfataric activity in the West Indies.

COOPERATIVE PROGRAMS

Cooperative Ship Weather Observation Program (NOAA)

Abby Ames, SEA Staff Scientist

The R/V Westward is certified to gather weather observation for the U.S. National Weather Service (NOAA) in conjunction with the Organization Meteorologique Mondiale. The data, which are collected at 0600 and 1200 GMT are transmitted to Coast Guard stations ashore and constitute part of a global weather observation network.

On W-42, 57 sets of observations were compiled of which 72% were successfully transmitted. Of these 76% were copied by NMN Portsmouth, Va., 23% were copied by NMG New Orleans and 2% by NMF Boston.

For our own purposes these observations (Table 5) comprise a meteorological record for the cruise.

SEASAT-A Surface Truth Validation (Jet Propulsion Laboratory, Pasadena, CA)

Thomas G. Reidenbaugh , SEA Staff Scientist

Abstract

The NASA SEASAT-A is the first experimental satellite designed for global ocean monitoring. During 1978, an intensive surface truth measurement program is underway to validate signals from SEASAT-A's 4 microwave and 1 visual/infrared sensors. R/V Westward joined the NOAA volunteer program of SEASAT-A surface truth validation during the W-42 cruise in the North Atlantic Ocean and Eastern Caribbean Sea. Standardized weather and sea surface observations were made at specific times and positions to coincide with 24 individual SEASAT-A orbital overpasses from 13 October through 19 November 1978. These data included ship's position, speed, and heading; 20-min observations of relative wind speed and direction; weather descriptive terms; barometric pressure; visibility;

Table 5 Weather observations for W-42.

$99L_aL_aL_a$	$Q_cL_oL_oL_o$	$YYGGi_w$	Nddff	VVwwW	PPPTT	$N_hC_LhC_MC_H$	D_sv_sapp	$OT_sT_sT_dT_d$	$1T_wT_wT_w{}^tT$	$3P_wP_wH_wH_w$	$d_wd_wP_wH_wH_w$
99410	77141	12034	02006	98050	17416	0////	31127	00016	11603	30201	18902
99406	70711	13064	82011	98020	18416	80/11	31201	00215	11608	3//00	14602
99401	70697	14064	82304	98032	17817	80/1/	31707	00216	11679	30100	10801
99401	70693	14124	81210	96025	16117	863//	11704	00417	11598	3//00	13601
99399	70693	15064	72207	97018	07918	754//	00220	00116	11762	3////	16503
99396	70693	15124	83014	98022	09017	3236/	42217	00814	12090	30402	27603
99381	70679	16064	50214	98012	15417	514//	32204	06711	12570	30405	33703
99375	70693	16124	43211	98011	17117	524//	31117	06116	12358	30201	34702
99362	70664	17064	61412	98023	15921	2246/	31412	00716	12425	30201	12702
99364	40671	17124	81115	97501	12921	873//	00400	05618	12400	30502	/////
99348	70668	18124	30225	99018	15518	325//	32220	06106	12459	30402	02006
99334	70658	19064	70506	98022	20019	744//	31400	06114	12459	30201	05702
99331	70652	19124	43205	98022	20020	32461	32400	05713	12439	30200	03702
99314	70628	22064	80105	98201	19224	885//	31400	05216	12520	30100	04603
99314	70641	22124	70408	98022	20522	1841/	31005	05319	12459	30100	34102
99301	70615	23064	30807	98011	18524	344//	31706	05321	12596	30100	00602
99288	70593	24061	81006	98020	12524	11337	31711	05318	12671	3//00	///00
99268	70583	24124	50902	99012	12324	21437	31402	05218	12545	3//00	01502
99261	70585	25064	00000	97020	10325	0////	32408	05418	12707	3//00	09801
99254	70582	25124	42903	98020	12227	18511	32317	00020	12745	30100	02901
99238	70582	26064	40000	98018	14526	3842/	42705	05322	12795	30000	04/01
99230	70581	26124	71302	98022	15526	782//	42213	05323	12805	30101	01802
99212	70582	27064	31507	97155	16126	223//	42713	05423	12822	3////	01/02
99213	70584	27124	71208	98152	16427	23419	82211	05224	12813	30201	04501
99206	70590	28064	80810	98022	15427	//4//	52708	00024	12788	30201	/////
99201	70591	28124	71304	97028	16526	7319/	51201	05423	12802	30201	06202
99189	70602	29064	21212	98151	13627	23300	51726	05224	12810	30101	11502
99180	70605	29124	51507	99031	13939	523//	52511	05225	12810	30202	07601
99173	70595	30064	21107	99501	13027	294//	51710	05223	12802	3//01	07/02
99170	70621	03064	41410	99180	13927	244//	00710	05124	12796	3////	13101
99175	70620	04064	11220	99250	14227	144//	00710	05126	12805	30402	/////
99173	70620	04124	21421	99020	14828	224//	//208	00022	12800	30201	14503
99171	70620	05064	10924	98020	14427	114//	31206	05023	12808	3////	09503
99172	70625	05124	11318	98010	14428	114//	11206	05224	12880	30401	/////
99169	70621	06124	70907	97848	15126	732//	40225	05423	12800	30000	90601
99168	70618	07064	10913	98000	13227	132//	00205	05124	12788	30000	09602
99165	70617	07124	10919	98020	14527	124//	51310	05123	12828	30401	05702
99157	70615	08064	30616	98010	12027	313//	31619	05225	12823	3////	/////
99154	70615	08124	40101	98030	13726	42361	31217	05124	12705	30100	15301
99141	70610	09064	30903	99011	11527	346//	31717	05325	12819	3////	08301
99140	70610	09124	80907	98606	13024	882//	00020	05624	12809	30200	11601
99136	70613	13064	00502	98020	10826	112//	00720	05324	12815	30200	/////
99135	70614	13124	10902	98010	11827	124//	40216	05323	12822	30101	07501
99135	70614	14064	30905	98020	11027	123/6	41710	05224	12802	30101	09702
99131	70612	14124	20901	98030	12727	122/4	00314	05424	12800	3////	08701
99130	70613	15124	50901	98030	12227	22341	00207	05226	12810	30201	13801
99130	70613	16124	40904	98020	10128	3238/	00701	05328	12800	3////	09201
99133	70614	17064	61110	98031	11926	5236/	71002	0//25	12820	30101	05501
99136	70618	17124	10502	99031	11227	123//	81310	05126	12818	30101	04502
99152	70626	18064	60709	98022	10527	47348	82615	05125	12810	30301	09615
99154	70624	18124	70905	98022	11927	3825/	82221	05224	12811	30201	11502
99169	70630	19064	80911	98022	13027	844//	82710	05024	12808	30201	05402
99175	70630	19124	70904	98022	14028	5346/	81210	00424	12793	30101	05502
99159	70179	20064	30904	97030	13227	1247/	61708	05124	12782	30101	09502
99179	70642	20124	10618	98011	13526	14569	71210	05424	12745	30501	//000
99171	70645	21044	30712	98021	10227	3441/	00720	05423	12762	30201	07402
99182	70645	21124	20810	98020	12026	21///	71210	05323	12760	30201	07402

Key: $L_aL_aL_a$= latutude 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 temp.; N_h = amount of lowest clouds; C_L = type of low cloud; h = height of lowest clouds; C_M = type of middle cloud; C_H = type of high 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 temp. difference; T_d = dew point; T_w = sea temp.; ${}^tT$ = tenths of air temp.; P_w and H_w = wind wave period and height; d_w - swell direction.

wet and dry bulb air temperatures; sea surface temperature; cloud cover; wind wave and swell heights, wavelengths, periods, and directions; and spacial rain patterns. These data will be forwarded to NOAA for inclusion in the SEASAT-A validation effort.

Satellite Images Aboard R/V Westward -

Images from the NOAA-5 Geostationary Operational Environmental Satellite (GOES), along with NOAA weather prognosis maps, are transmitted several times daily by the U.S. Coast Guard. These may be received on the Alden 11 MarineFax plotter aboard R/V Westward. The GOES sensor is a visible/thermal infrared radiometer similar to the visible/IR radiometer on SEASAT-A. It provides day and night mapping capabilities for cloud cover, and clear-weather mapping capabilities for sea surface temperatures. Both cloud and sea surface temperature imagery/maps may be received on the MarineFax.

During the SEASAT-A proof-of-concept mission, there is no SEASAT-A imagery available to non-contract users, so there is no SEASAT-A feedback to R/V Westward.

Addendum in Proof - Malfunction of the SEASAT-A Satellite -

The planned 1-year proof-of-concept mission of the NASA SEASAT-A oceanographic satellite was prematurely terminated by an apparent electrical short circuit which disabled the spacecraft 10 October 1978, preceding all of the surface truth measurements undertaken aboard R/V Westward during W-42. A massive current drain from SEASAT-A's 2 nickel-cadmium storage batteries was first monitored at 0330 GMT by the Santiago, Chile, ground station. The last confirmed contact with SEASAT-A was shortly thereafter, by the Orraral, Australia, ground station, which picked up control of the satellite immediately after Santiago, and continued to detect a current drain.

SEASAT-A's primary electrical system is composed of 2

11-panel solar arrays; the storage batteries form a power subsystem for peak power requirements and for when the solar panels are not illuminated. At last contact, voltage output of the batteries was too low to maintain sensors, receivers, or the data link transmitters. Commands to isolate the short circuit apparently failed. Without power, the SEASAT-A sensors probably dropped to temperatures below their lower stress limits.

Prospects to revive the satellite appear extremely dim. It remains in frozen -- or altitude calibration -- orbit in which it overflies the Bermuda ground station once every 3 days. It has not been fired into Cambridge orbit which repeats every 37 days, as was originally planned for 26 October. Projected overflights of the W-42 cruise track assumed Cambridge orbit after 26 October, and thus did not correspond to actual positions of the disabled SEASAT-A. NASA/NOAA validation of SEASAT-A data must now be completed for only 99 days that the sensors were operative.

Sources of Sea Swell in the North Atlantic Ocean

David Neiburg

Data on swell height and direction (collected routinely aboard Westward) were examined in an attempt to associate specific swell with a known weather system. Maps of storm systems and the distribution of significant wave height for the North Atlantic are regularly transmitted by Coast Guard stations and received aboard Westward by MarineFax.

It appears that swell encountered on Leg 1 (Fig. 2) can be attributed to two major weather systems.

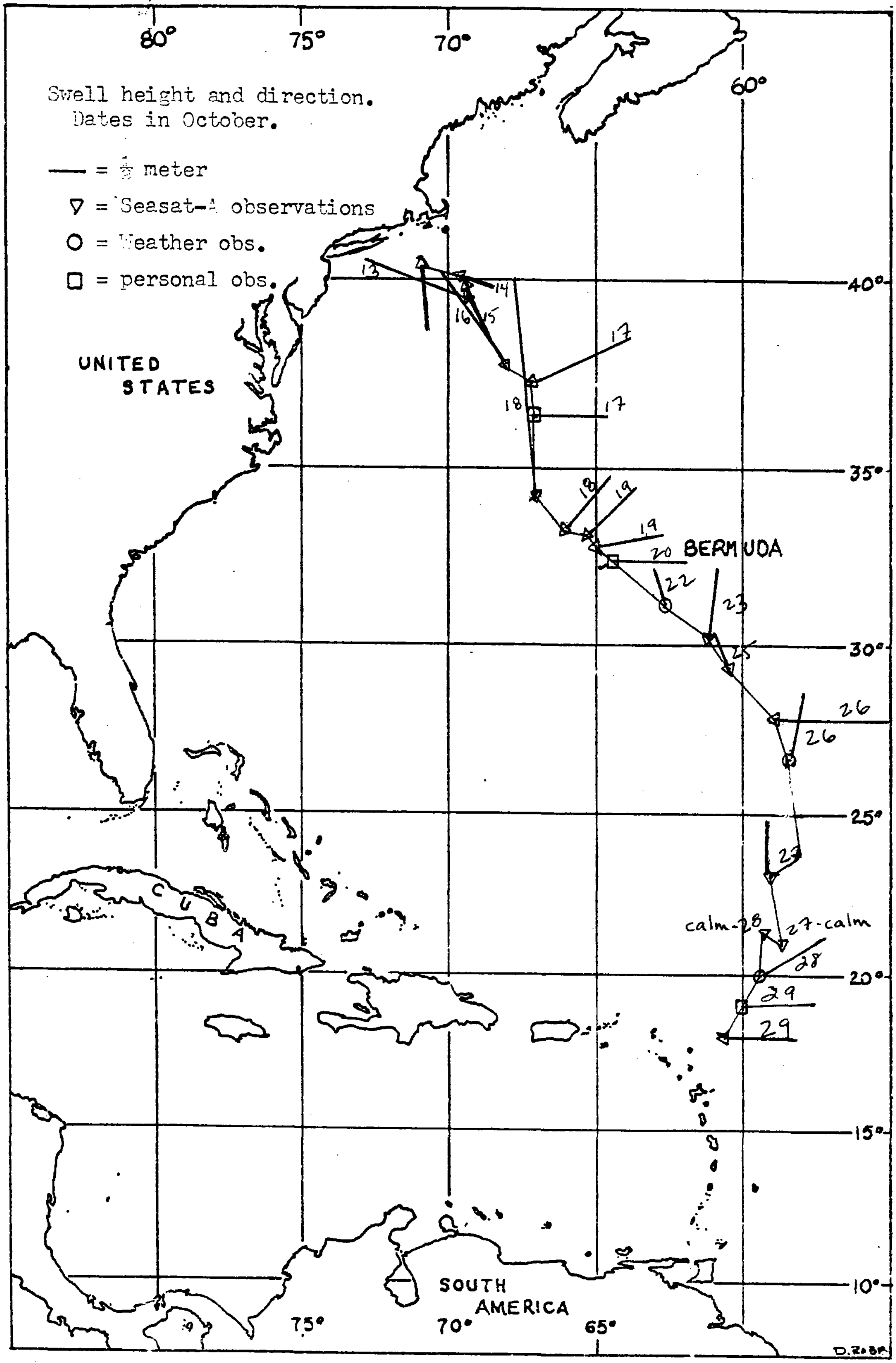


Fig. 2 Swell height and directi.... Leg.1 of W-42.

Gulf Stream Transect

Joanne Willey

Surface temperatures were taken to monitor our passage into the Gulf Stream. Fig. 3 gives the mean position of the axis (solid line) and the position reported for the north wall by NOAA (transmitted by NMN CG Portsmouth). From approximately 50 trackline temperature data, we surmise the position of the north wall was slightly north of this area by October 15 when we crossed the 20°C isotherm. Eastward set of the ship indicates the effect of the current as our course at this time was 180°. A dip in temperature after first entering the stream is consistent with the ship's course and the large meander feature shown in Fig. 3.

Heat Budget of a Cumulonimbus Cloud

During Westward's passage in waters south of 30°N cumulus clouds and the more vertically developed cumulonimbus clouds were commonly in sight. These clouds are a manifestation of an important mechanism by which heat (latent and sensible) is transported from the ocean to the atmosphere. At the intertropical front, near the meteorological equator, giant cumulonimbus clouds, or "hot towers," transport this heat to altitudes in excess of 35,000 feet and start it in its poleward movement -- which ultimately balances the global heat budget.

On October 28 at about 20°N latitude we experienced a number of squalls associated with cumulonimbus clouds. For one of these clouds, bucket rain gauges were placed at two parts of the ship to measure precipitation, and radar was used to determine the size of the cloud.

This squall took 15 minutes to pass over us, and dropped precipitation at 0.050 ($\pm$0.001)cm/min. The cloud radius was about 1850 m and the time from initial formation of the cloud to its dissipation was about 135 min. The amount of heat released in the atmosphere in association with this precipitation would therefore have been 2.9×10^{12} cal min^{-1} or 3.9×10^{14} cal in the lifetime of the cloud. This amounts to 27 cal cm^{-2} min^{-1} which is about 300 times the average rate at which solar radiation is delivered to the ocean's surface at these latitudes and more than 500 times the rate it is delivered to the atmosphere.

Tropical Cyclone "Kendra"

Tropical cyclones are not generally associated with frontal systems like storms produced at higher latitudes. Instead, they often begin with a wave phenomenon in the easterly trade winds -- a so-called "easterly wave." Only a small proportion of easterly waves actually lead to tropical cyclone formation, and those seem to have four conditions in common: a) an extensive warm ocean surface; b) a deep layer of moist, unstable air; c) a latitude of 5° or higher; and, d) small vertical shear (Harvey, 1976)1/.

We observed conditions during W-42 which were related to the formation of hurricane Kendra. This depression owed its origin to an easterly wave which formed off the coast of North Africa on October 15. The westward passage of the wave was marked by very heavy precipitation at Antigua on October 22 and by up to 18 inches of rain at Puerto Rico on October 26.

Over the same interval a front extending SW from a low centered at about 40°N, 45°W penetrated the subtropical ridge and became stationary SW to NE across the Atlantic. Tropical storm Kendra formed between this old frontal zone and the easterly wave and assumed hurricane status October 28 east of the Bahamas.

Clouds associated with this system are visible on photographs from the NOAA-5 GOES satellite, which are received aboard Westward. Fig. 4 shows the October 25 image when our position was about 25°N, 59°W. On October 24, 25, and 26 we experienced light and variable winds and glassy sea conditions. To the north the frontal zone was visible as a dark, silvery band. Overhead and to the south cloud conditions were extremely chaotic: middle and high stratus and cirrus, low and middle spotty cumulus. The cover was sufficiently

1/ "Atmosphere and Ocean" Artemis Press

Fig. 4. The October 25, 1978 photo taken from the GOES satellite and received aboard Westward using an Alden 11 MarineFax plotter. Westward's position on this photo is about 25°N, 69°W.

thin or spotty to allow navigational sun lines to be taken. By 21°N the easterly trade winds filled in (normally they appear at 25°N) although the sky remained chaotic for two more days.

During this interval there was a distinct sense of disquiet, listlessness and fatigue aboard ship. The exact relationship this bears to the weather is impossible to establish.

Shark Tagging Program (National Marine Fisheries Service)

Susan Dierdorff

Abstract

In cooperation with Dr. Jack Casey of the Narragansett Laboratory, 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 Northern Atlantic.

During the W-42 cruise, four longlines were set for sharks in the Lesser Antilles in the Eastern Caribbean (Table 6). For bait we used half a Menhaden (Pogi)/hook which had been thawed, gutted and packed in salt brine for 4-5 weeks. Our only catch was a female blue shark (*Prionace glauca*) about 6 feet long. The reasons for our poor results concerned the bait and problems in reaching our intended position over the banks.

Table 6 W-42 Longlining Results

Date	Position	Time In	Time Out	Time Overboard	# Hooks	% Unbaited
11/03/78	17°2.1'N 62°6.2'W	0550	1015	5.8 hrs.	40	50
	17°5.0'N 62°11'W	0620	1145			
	Catch: 1 <u>Prionace</u> <u>glauca</u>, female, 6 feet, approx. 70 lbs.; released uninjured					
11/04/78	17°29.4'N 62°3.2'W	0632	1250			
	17°27.6'N 62°5.8'W	0700	1415	7.75 hrs.	40	60
	Catch: None					
11/13/78	13°30'N 62°22'W	0545	0937	4.25 hrs.	38	10
		0610	1000			
	Catch: None					
11/14/78	13°4.5'N 61°15'W	0615	0950	4.5 hrs.	40	40
	13°3.3'N 61°14.4'W	0638	1050			
	Catch: None					

Ichthyoplankton Neuston Sampling (National Marine Fisheries Service)

Abby Ames, SEA Staff Scientist

Twenty-five neuston samples collected on W-42 (Table 10) will be forwarded to the National Marine Fisheries Service - Miami, where they will be examined for larval fish content. This cooperative program coordinated by Dr. William Richards is directed at clarifying the life histories of important sport fisheries species.

Heterotrophic Microbial Metabolism in Marine Sediments

Sally Hornor, Syracuse University

The purpose of this research on W-42 was to estimate rates of respiration of marine sediments in different oceanic environments as an indication of the rates of heterotrophic decomposition of detrital material by benthic microbial communities. By measuring rates of O_2 consumption in intact cores, we are able to compare the metabolic activities of the entire aerobic benthic community of areas which differ greatly with respect to faunal composition, geology and geography. Understanding of the interactions of biotic and abiotic components of benthic communities is essential from both a purely scientific viewpoint and for the applied aspects of fisheries productivity and ocean dumping of potentially toxic materials. Respiration measurements provide an integrative approach to intact sediment systems by estimating the net result of the biochemical and biological activities.

Comparative Rates of Oxygen Consumption in Sediments of English Harbor, Antigua and Shelf Sediments in the lee of Guadeloupe.

Sally Hornor

Abstract

Oxygen consumption rates of sediment cores collected in English Harbor, Antigua and in shelf waters off Guadeloupe were measured. The sediments of English Harbor (collected from a water depth of 4 m) were more reduced and contained a higher organic content than those off Guadeloupe (collected at 692, 785 and 872 m). Although the sediment column of English Harbor

was only a fraction of that observed of Guadeloupe, the O_2 consumption rates were more than twice as high. Guadeloupe cores showed a mean respiration rate of 12.9 ml O_2 m^{-2} h^{-1} (S.D. = 3.8) while cores from English Harbor consumed an average of 31.9 ml O_2 m^{-2} h^{-1} (S.D. = 4.2).

Phosphorus Release and Oxygen Consumption of Marine Sediments

Joanne Willey

Abstract

The release of phosphorus and the concomitant consumption of oxygen in a core sample from Marigot Bay, a sandy embayment in St. Lucia was measured. A decrease in oxygen concentration of 0.455 ml/liter was observed in samples incubated in the dark for seventy hours. The release of phosphorus from the sediment averaged 1.78 μ M/meter^2/hour, while an oxygen consumption of 799 μ M/meter^2/hour was observed. This ratio of phosphorus to oxygen is about three times higher than predicted for aerobic organic matter decomposition according to a published model.

Heterotrophic CO_2 Productivity in Cores of Marine Sediments from English Harbor, Antigua

Arthur Gaines, SEA Staff Scientist

pH changes in water overlying cores examined by Hornor (see above) are assumed to result from additions of the weak acid H_2CO_3 (i.e., from addition of dissolved CO_2). On this basis, with the use of the Henderson-Hasselbalch approximation ($pH = pK_a + \frac{A^-}{HA}$), it is possible to estimate the rate of CO_2 evolution by the sediments, if seawater alkalinity and other properties measured by Hornor are known.

The results for two cores indicate rates of 25.6 ml CO_2 $M^{-2}hr^{-1}$ and 68.5 ml CO_2 $M^{-2}hr^{-1}$. Using other data for these cores from Hornor, RQ's of 1.5 and 1.2 are calculated. These values suggest appreciable release of CO_2 by anaerobic microbial processes since the typical RQ for oxidative dissimilation of organic matter is about 0.85 (Hornor, personal communication).

LONG TERM INTERNAL PROGRAMS

Marine Mammals (Cetaceans)

Thomas G. Reidenbaugh, SEA Staff Scientist

An ongoing survey of marine mammals was continued during W-42 in the North Atlantic and Eastern Caribbean. This effort was three-fold, all dealing with cetaceans: 1) observations of great and small whales, 2) observations of dolphins, and 3) hydrophonic listening for cetacean vocalizations. A total of 14 cetacean sightings was made, including 1 species of great whale, 1 species of small whale, and 2 species of dolphins. These are reported separately by Miller (whales) and Jenks (dolphins). 14 hydrophone acoustic stations were conducted by schedule or in response to cetacean sightings (Table 8).

Near-continuous daylight watches were maintained in the foremast spreaders (64 ft. above sea surface, horizon about 9 n. mi.) for cetacean sightings near the Lesser Antilles from Antiqua to Tobago Cays (2 through 15 November 1978). This segment included several passages to Caribbean wintering grounds where whales may be intersected during their southward migrations. Regular deck watches (horizon about 3 n. mi.) were periodically supplemented by spreader watches during other segments of the cruise track.

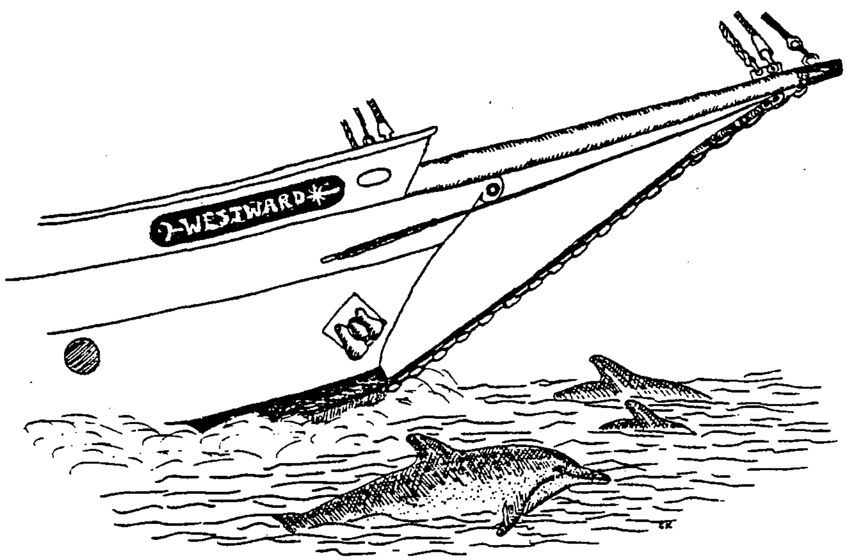
Quality of cetacean identification was excellent. All daylight sightings were positively identified, with 1 exception of dolphins at great distance. Cetacean identification sheets prepared and used during W-42 are included in Appendix 5.

Dolphin Sightings

Jeff Jenks

Abstract

During cruise W-42 seven dolphin sightings were logged (Fig. 5). These included one sighting of Atlantic Spotted Dolphin (Stenella plagiodon) and six sightings of Atlantic Bridled Dolphin (Stenella frontalis). All but one sighting occurred below N 17 00'. All these sightings were made either on the lee side of islands or in the island passages. The sightings occurred in the coastal waters of the island. An identification key was compiled to aid in the identifications. This key is included in Appendix 5.



Bridled Dolphins Stenella frontalis

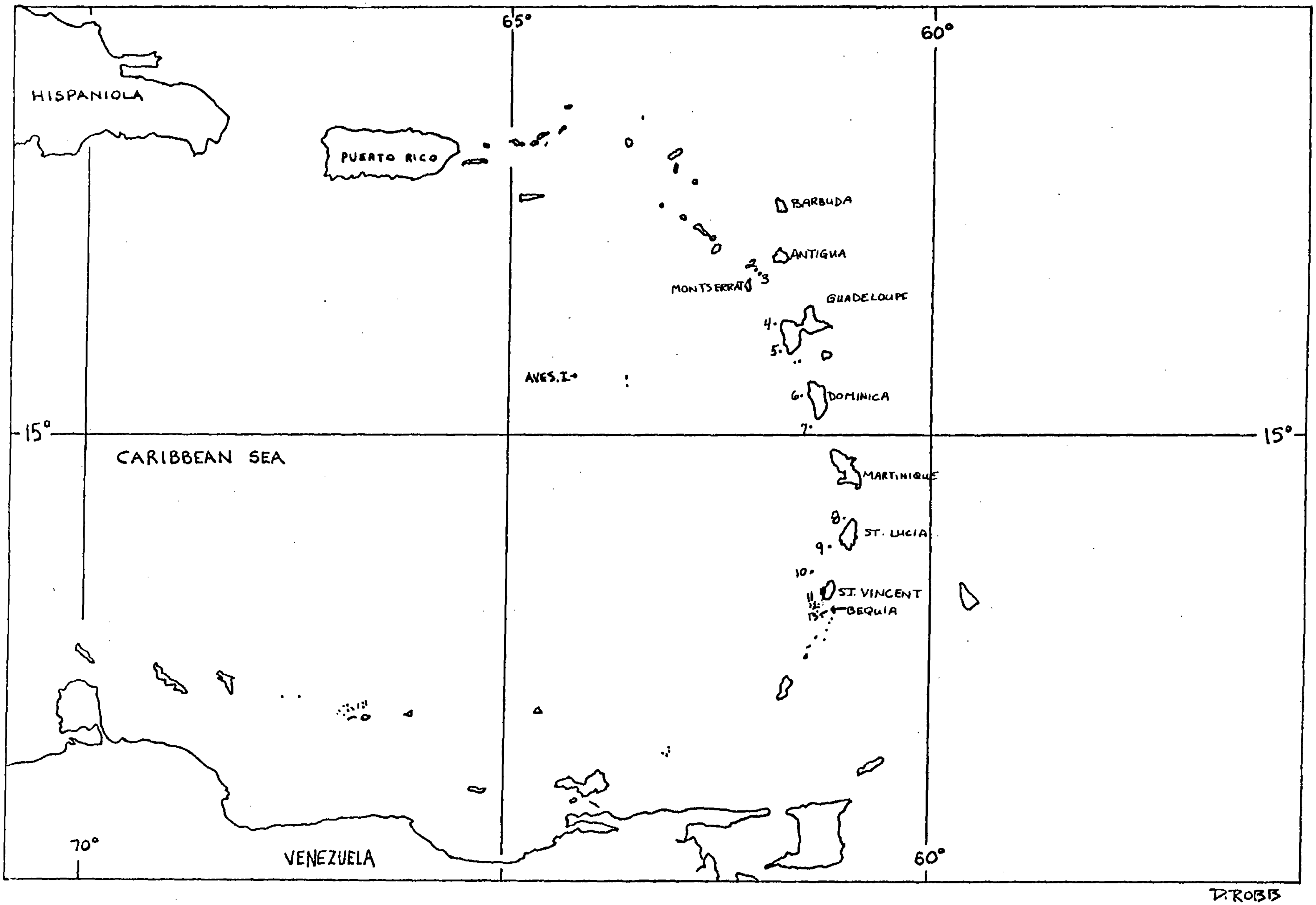


Fig. 5 Marine mammal sightings. W-42. See Table 7.

Table 7 Marine Mammals Sighted During W-42

Obs. #	Common Name	Latin Name	I.D.	#	Date	Time	Location	Mode
1	Atlantic Spotted Dolphin	Stenella plagiodon	1	7-10	10/22	1515	N31 00' W61 42'	S
2	Sperm Whale	Physeter catadon	2	1	11/06	0815	N16 55' W62 03'	S
3	Sperm Whale	Physeter catadon	1	1	11/06	0850	N16 53' W62 02'	S
4	Atlantic Bridled Dolphin	Stenella frontalis	1	40-50	11/07	0945	N16 18' W61 50'	S
5	Atlantic Bridled Dolphin	Stenella frontalis	1	40-50	11/07	1630	N16 04' W61 51'	HT
6	Atlantic Bridled Dolphin	Stenella frontalis	1	30-40	11/08	0600	N15 31' W61 31'	S
7	Short-finned Pilot Whale	Globicephela macrorhynchus	2	6-8	11/08	0835-0855	N15 12' W61 25'	P
8	Unidentified blows	---	--	1	11/09	0455	N14 03' W61 02'	S
9	Atlantic Bridled Dolphin	Stenella frontalis	2	5-10	11/12	2330-0015	N13 44' W61 14'	S
10	Atlantic Bridled Dolphin	Stenella frontalis	1	35-45	11/13	1600-1615	N13 24' W61 26'	P
11	Atlantic Bridled Dolphin	Stenella frontalis	2	5-7	11/14	0245	N13 08' W61 14'	P
12	Unidentified Dolphin	---	-	10-20	11/14	0520	N13 04' W61 13'	S
13	Sperm Whale	Physeter catadon	1	5-7	11/14	0740-0900	N13 06' W61 16'	S

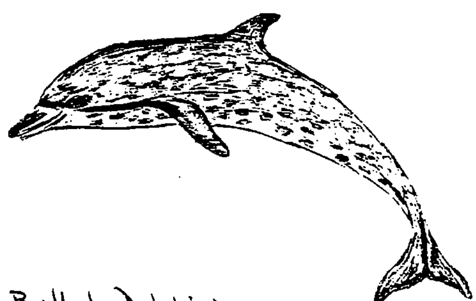
Whale Sightings and Cetacean Vocalizations

Julie A. Miller

Abstract

Whale watches were maintained throughout W-42 resulting in ten sightings of whales (Fig. 5). A pod of seven short-finned pilot whales (Globicep hala macrorhynchus) was sighted off Dominica and the other nine sightings were all sperm whales (Physeter catadon). Sperm whales are believed to migrate from the Atlantic to the Caribbean through the passages between the islands of the Lesser Antilles. All of our sperm whale sightings were made near these passages.

Hydrophone listening stations were undertaken periodically, detecting dolphin vocalizations. These consisted of series of whistles, clicks and squeaks (Table 8).



Bridled Dolphin
Stenella frontalis

Table 8 W-42 Acoustic Stations. 8-15 November 1978

No.	Date	Time	Position	Location	Tape	Comments
1	11/08	1345- 1415	N14 48' W61 16'	Martinique	1(1)	Vocalizations (+)
2	11/09	0336- 0400	N14 10' W61 14'	St. Lucia	1(2)	No vocals. (-)
3	11/09	0505- 0535	N14 05' W61 14'	St. Lucia	none	Cetacean nearby (+); tape failed.
4	11/12	1606- 1631	N13 53.0' W61 11.6'	St. Vincent Passage	2(1)	(-)
5	11/12	2110- 2135	N13 46' W61 15'	St. Vincent Passage	2(2)	(-)
6	11/13	0025- 0125	N13 40' W61 30'	St. Vincent Passage	3(1) 3(2)	Dolphins nearby. (+)
7	11/13	0420- 0445	N13 35' W61 17'	St. Vincent Passage	4(1)	(+)
8	11/13	0836- 0847	N13 34' W61 25'	St. Vincent Passage	4(2)	(+)
9	11/13	1220- 1300	N13 32' W61 32'	St. Vincent Passage	5(1)	(+)
10	11/13	2205- 2235	N13 25.3 W61 25'	St. Vincent Passage	5(2)	(+)
11	11/14	0010- 0045	N13 22.5' W61 25'	St. Vincent	6(1)	(-)
12	11/14	0830- 0844	N13 03.6' W61 16.3'	Bequia	6(2)	Cut short by weather. (+)
13	11/14	1210- 1240	N13 02.6' W61 17'	Bequia	7(1)	(-)
14	11/14	0800- 0830	N13 00' W61 15'	Bequia	7(2)	(-)

Bird Observations on the Open Ocean

Andrea D'Aquilla

Westward cruises during the past 1-1/2 years have included attention to the air fauna, at the initial instigation of Peter Frederick (formerly of Swarthmore College; see W-33 Cruise Report).

The bird observation program on W-45 had two approaches: 1) discrete intensive 10-minute observation watches during which I scanned the sea surface; and 2) instructions to the 24-hour ongoing science and deck watches to call me if a bird were sighted. Results of the second approach are quite difficult to interpret because very few people on board were practiced at bird observation. Birds landing on the ship (mainly terrestrial species) would most certainly be spotted but pelagic or coastal birds, even common species, might easily be missed.

Pelagic Bird Observations

Andrea D'Aquilla

Abstract

While at sea, a continuous bird log was kept During ten minute observation watches, a total of thirty-two species were recorded: 9 pelagic species; 14 shore species; and 9 terrestrial species (Table 9; Fig. 6-9). Of the nine pelagic species, Greater Shearwaters were the most abundant (see Fig. 10). The nine terrestrial species included five species which appeared to be unsuccessful migrants, landing on the ship the day before we encountered gale force conditions in the North Atlantic. The only area with a significant absence of birds was the horse latitudes, an atmospheric downwelling zone which may inhibit bird passage. Most common pelagic birds of the Caribbean were represented in this log.

Table 9 Birds Observed During W-42 and Reference Numbers (see Figs. 8 and 9).

Ref #	Species	# Observed
	Shearwater	
1.	species	-10
2.	Fulmar	- 1
3.	Greater	-73
4.	Sooty	- 1
	Storm-Petrel	
5.	species	- 2
6.	Wilsons	- 2
7.	Brown Pelican	- 1
8.	Brown Booby	- 4
9.	Double-crested cormorant	- 1
10.	Magnificent Frigate Bird	-19
	Egret	
11.	species	-11
12.	Cattle	- 1
13.	Parasitic Jaeger	- 1
14.	Great Skua	- 5
	Gull	
15.	species	- 2
16.	Herring gull	- 4
17.	Laughing gull	- 1
18.	Kittiwake	- 1
	Tern	
19.	species	-60
20.	Bridled	- 2
21.	Gull-billed	- 1
22.	Sooty	- 1
23.	Kingfisher	- 1
24.	Vireo species	- 1
	Warbler	
25.	Myrtle	- 1
26.	Palm	- 1
	Sparrow	
27.	species	- 2
28.	Savannah	- 1
29.	White-crowned	- 1
30.	Slate-colored Junco	- 1
	Swallow	
31.	species	- 1
32.	Barn	- 1

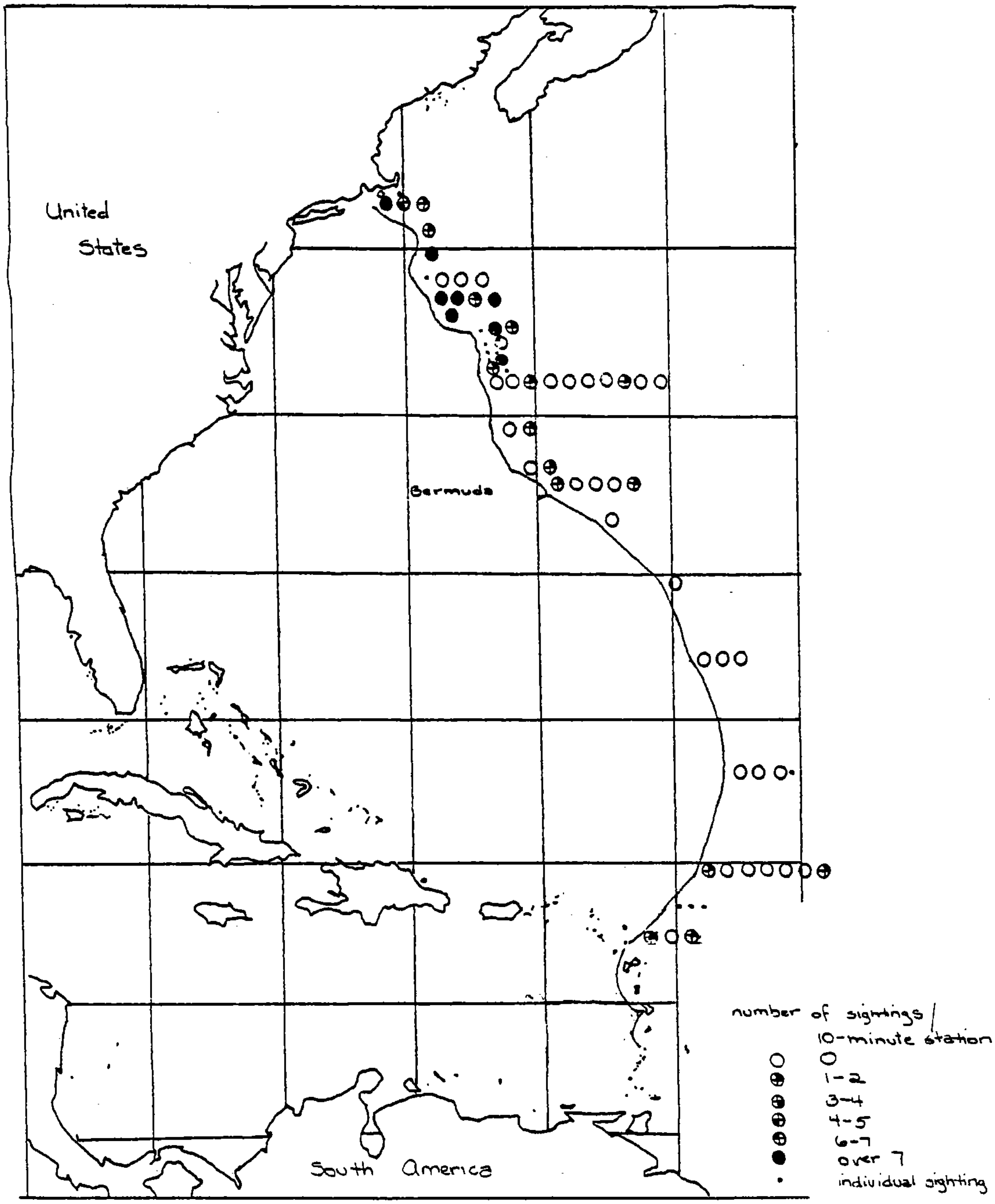


Fig. 6 Bird observation stations and sightings, W-42, Leg 1. October 1978.

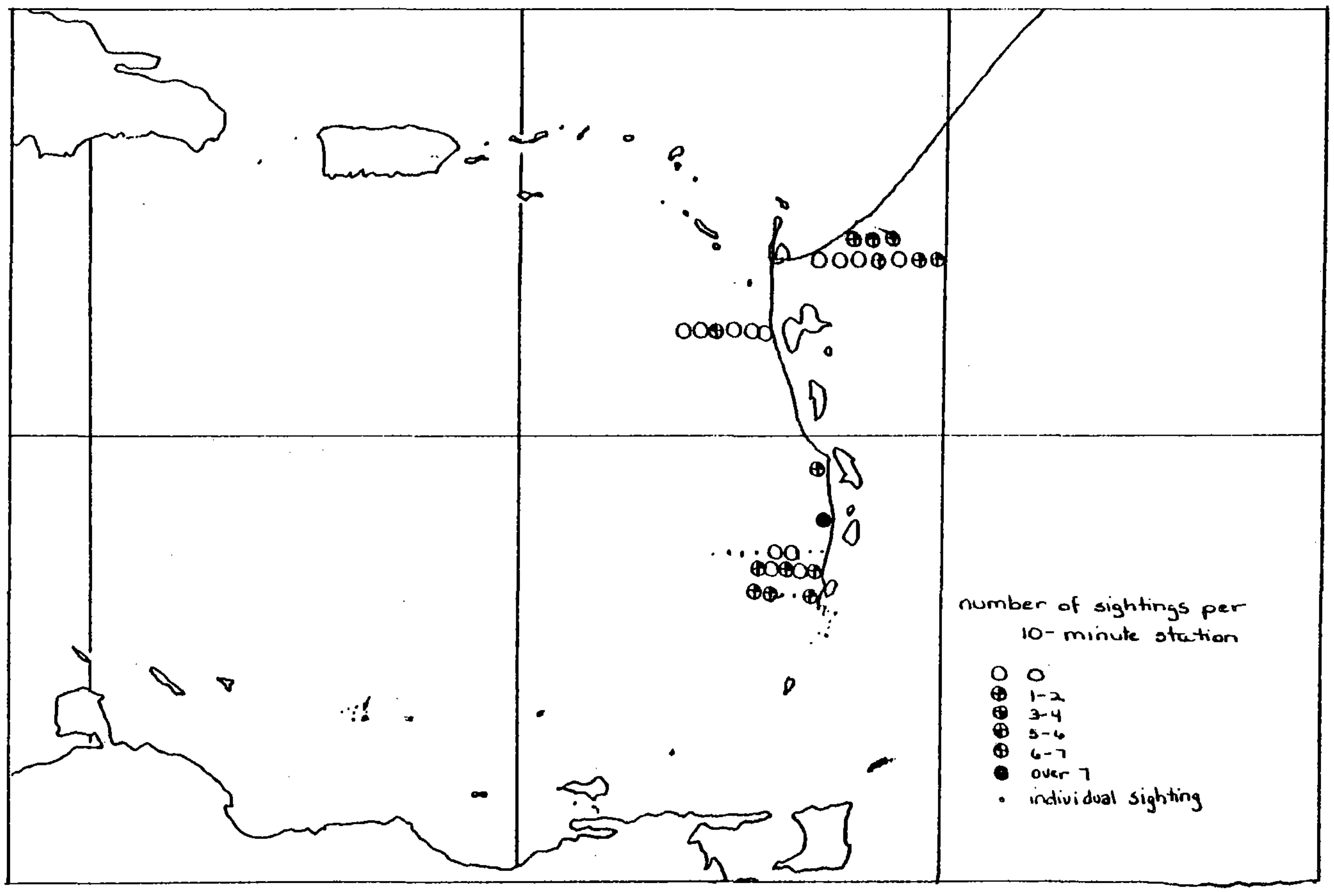


Fig. 7 Bird observation stations and sightings, W-42, Legs 2 and 3. November 1978

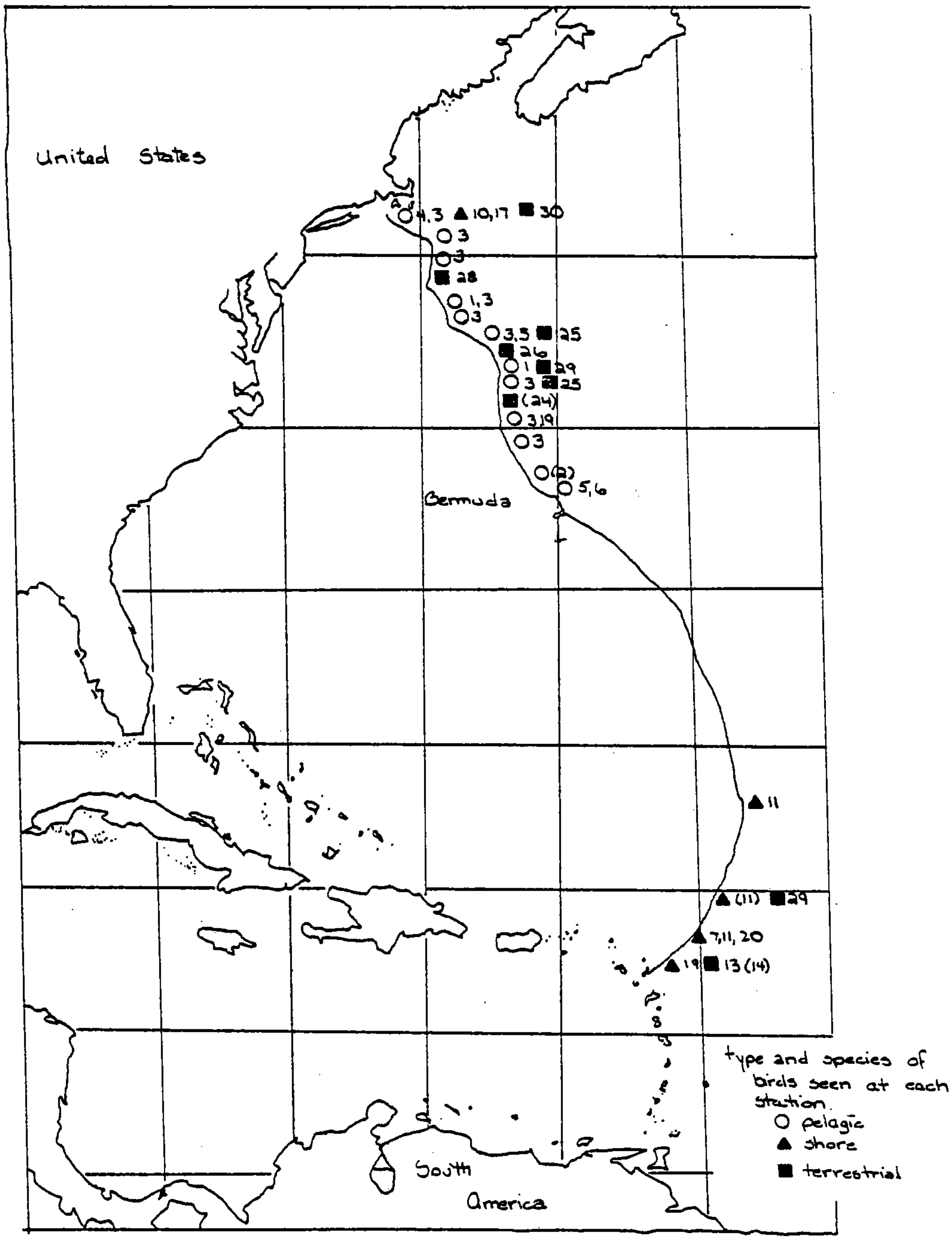


Fig. 8 Bird species sighted during leg 1 of W-42. October 1978.

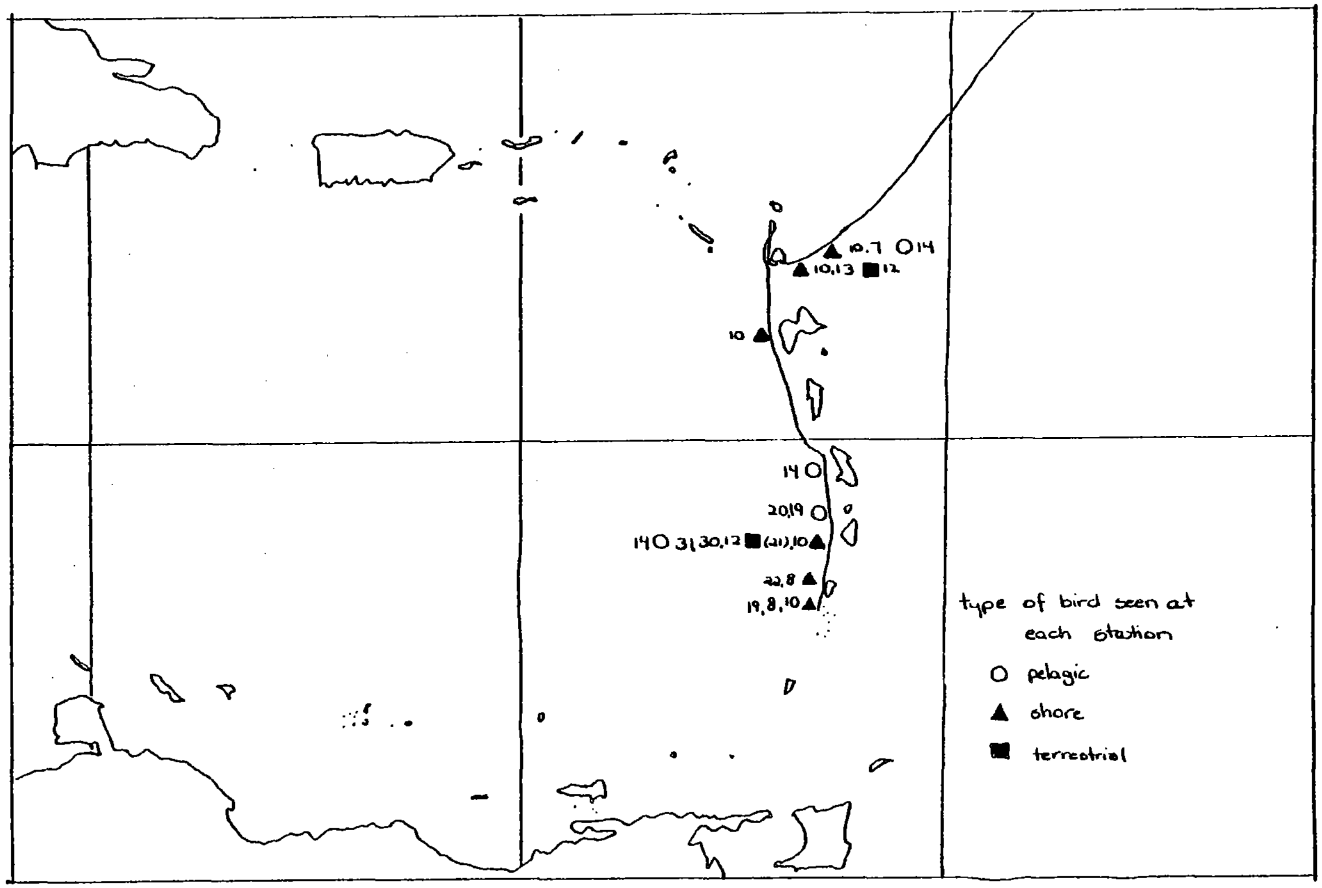


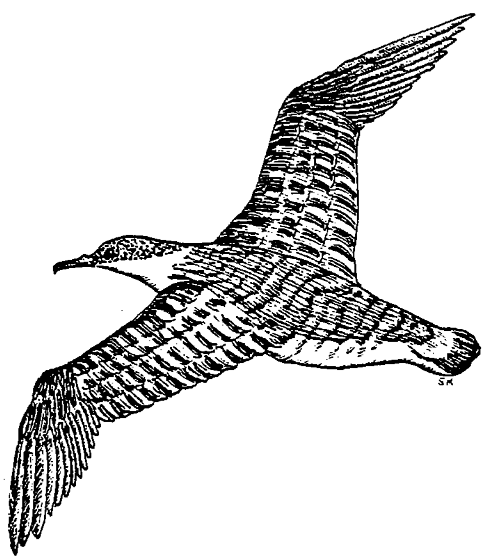
Fig. 9 Bird species sighted during legs 2 and 3 of W-42. November, 1978.

Possible Determining Factors in the Migration Routes of the Greater Shearwater.

Cynthia Thomson

Abstract

Numbers of Shearwaters (Puffins gravis) sighted along the W-42 cruise track from Woods Hole, Mass. to Bermuda, were compared to distance from ship to a 10 mb change in atmospheric pressure, distance from ship to a 10 mb drop in pressure, distance from ship to a 10 mb rise in pressure, pressure at the ship, surface temperature of the ocean, and distance from land. Increased distance from land was an important positive determinant of Shearwater abundance. The other factors were found not to be significant. It seems that migration routes of this pelagic species are not determined by surface pressure or sea surface temperature but rather to distance from land.



Greater Shearwater *Puffinus gravis*

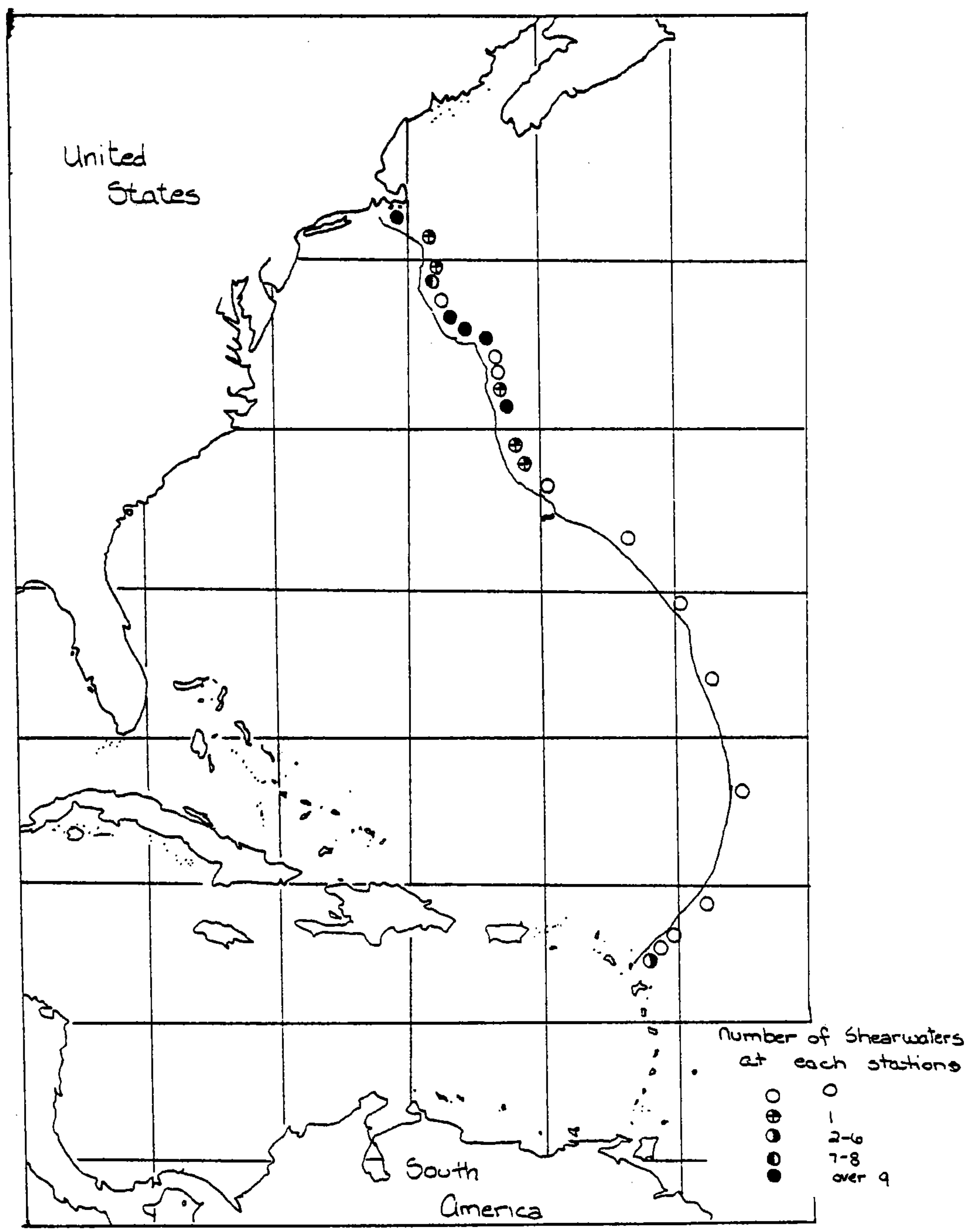


Fig. 10 Shearwaters sighted on leg 1 of W-42.
October, 1979.

Sargassum Community Studies

<u>Productivity of the Pelagic Sargassum Community</u>

Diana McCargo

Abstract

Sargassum natans (group fucales), is a pelagic brown alga that uniquely exists in a free floating state in the warm, nutrient poor waters of the Sargasso Sea and the Caribbean. It reproduces asexually and supports a diverse community of epiphitic organisms; it is a conspicuous primary producer of these unproductive or 'desert' seas. An examination was made of the productivity rates of individual wisps of Sargassum weed using the Light and Dark Bottle Method in combination with the Winkler Titration Method (Strickland and Parsons, 1972). From these calculations the productivity rate was determined to be relatively high for these respective seas, but proportionally low in relation to other marine environments.

The Respiration Rate of Sargassum

Melonie Wilson

Abstract

The respiration rates of sargassum in the northern Sargasso Sea and the Caribbean were determined by the Dark Bottle Method. The two rates expressed on a wet weight basis were -0.33 ml O_2/g/hr and -0.27 ml O_2/g/hr. The figures represent the respiration of both the weed and the epiphytic life on it. These results agree with those of Welsh, 1977 (W-33 Cruise Report; R{ml O_2/g/hr} = -0.30; -0.30; -0.46).

Sargassum natans

Neuston Studies

The neuston, or "surface dwellers," is a category of plankton which has received attention only for the past 15-20 years. Since the air-sea interface tends to concentrate certain pollutants and other anthropogenic materials the neuston has recently been regarded as a potential early warning system for environmental degradation.

For more than a year Westward cruises have routinely carried out neuston tows and certain shipboard analyses of the catch. On W-42 25 neuston tows were conducted and analysed for the content of tar balls, *Sargassum* weed and the marine insect *Halobates* (Table 10).

Pelagic Tar

Tar balls are believed to originate from crude oil lost during tanker washing (Butler *et al*. 1973. Bermuda Biological Station Spec. Pub. 10) and have a life time at sea of a year or more. Their distribution would be a function of washing activity, movement by marine and atmospheric processes and deterioration of the tar.

Despite strong variability in successive tows, the distribution we saw on W-42 is consistent with that a year ago (see W-36 Cruise Report), and with the published accounts: pelagic tar is most concentrated in the Sargasso Sea, in the general vicinity of Bermuda. Our data show lower amount of tar south of 30°N.

Sargassum Weed

Sargassum weed is of interest to us in connection with an ongoing study on trophic dynamics in the Sargasso Sea. *Sargassum* weed is a conspicuous primary producer and its standing crop is therefore of interest.

Considering data only from the Sargasso Sea, i.e., between $23^{\circ}N$ and $37^{\circ}N$ on our cruise track, the mean standing crop was 58.8 mg M^{-2} (S.D. = 85.1; range = 264). This did not differ appreciably from the result on W-36 a year ago for which the mean was 73.8 (S.D. = 85.9; range = 220).

Halobates

Of 750,000 species of insects only one, *Halobates micans*, completes its life cycle at sea. This insect, a water strider, is collected in the neuston net and we have recorded its abundance for several cruises.

The mean abundance, 8,500 Km^{-2} did not differ significantly from last year's average, 3,900 Km^{-2}. The correlation coefficient between abundance of *Halobates* and *Sargassum* was -0.3: the peak concentration of the insect occured where *Sargassum* was absent (Table 10).

Table 10 Summary of W-42 Neuston Tow Results.
Calculated concentrations are based on an area filtered of 1544 m^2/tow (2.5 kts for 20 minutes).

Tow #	Date	Time	Position (N&W)	Tar Balls ($1.0^{-3}g\,m^{-2}$)	Sargassum ($10^{-3}g$ wt wt m^{-2})	Halobates (1000/Km^2)	Temp (°C)
W-42 N1	10/13	1154	40 33; 70 48	0.0	0.0	0	15.8
" N2	10/22	1103	31 06; 62 31	6.5	100	1.9	24.8
" N3	10/22	1147	31 09; 61 52	10.8	264	1.3	25.6
" N4	10/22	2000	30 25; 61 28	16.8	17.6	9.7	26.7
" N5	10/23	1140	29 20; 60 27	12.3	113	0.0	26.3
" N6	10/23	1955	28 34; 59 51	6.1	20.3	7.8	26.6
" N7	10/24	1137	27 23; 59 09	1.5	19.8	1.3	27.6
" N8	10/24	2002	26 48; 58 30	6.5	174	7.1	27.1
" N9	10/25	1130	25 19; 58 30	1.9	84.6	3.9	27.4
" N10	10/25	2011	25 24; 58 12	2.9	2.8	3.2	27.8
" N11	10/26	1130	22 43; 58 18	1.9	8.5	4.5	27.9
" N12	10/26	2000	22 08; 58 25	0.26	0.0	10.4	27.8
" N13	10/27	1157	21 21; 58 41	0.0	0.0	40.2	27.9
" N14	10/28	2015	20 06; 59 00	1.7	0.0	26.6	27.1
" N15	10/29	1132	18 00; 59 10	1.6	0.0	2.6	28.1
" N16	10/29	2000	17 18; 59 30	0.19	0.0	20.7	28.1
" N17	11/02	2155	17 00; 62 06	0.65	17.6	9.7	-
" N18	11/03	1300	17 04; 62 05	5.3	1.5	11.7	-
" N19	11/03	1957	17 23; 62 02	1.5	58.2	21.4	-
" N20	11/04	2012	17 08; 62 02	0.0	16.9	0.0	27.9
" N21	11/05	1121	17 23; 61 54	1.2	32.4	0.6	27.8
" N22	11/05	2211	17 28; 61 58	1.7	77.3	11.0	-
" N23	11/06	2026	16 52; 61 45	5.7	0.0	12.3	27.9
" N24	11/07	1136	13 49; 61 12	0.0	0.0	4.5	28.4
" N25	11/13	2010	13 25; 61 25	0.0	94.6	0.0	28.0
			Mean	3.5	44.1	8.5	
			Standard deviation	4.4	65.3	9.8	
			Range	16.8	264	40.2	

INTERNAL PROGRAMS FOR W-42.

The Search for Echo Bank

David Jenkins

Abstract

Echo Bank has long been a mystery of the sea. In waters over 2800 fathoms deep and approximately 240 miles northeast of the island of Anguilla, its position has been reported only three times to date. The first, in 1837, by the Dutch brig *Echo*. A rocky bottom was reported, but the Bank was removed from charts in 1898. The U.S. ship *Wm. Johnson* again reported finding Echo Bank on December 31, 1946 with a fathometer record of 36 fathoms. The last sighting was by a French pilot as he flew over the position in May or June of 1969, and reported seeing shallow water.

It has recently been proposed by Dr. Howard E. Winn of U.R.I. that Echo Bank may not be a physical phenomenon, such as a seamount, but may instead be of biological origin. American (*Anguilla rostrata*) and European (*Anguilla anguilla*) eels are conjectured to spawn between Bermuda and the Greater Antilles. Dr. Winn proposes that Echo Bank may actually be a mass of spawning eels, therefore being nonpermanent and difficult due to overcast skies and the lack of reliable LORAN navigation in this area.

The fathometer did not show any depths shallower than its limit of 100 fathoms. The BT and hydrocast data did not indicate the presence of such a feature, and lookouts spotted no variations in water characteristics. The biological samples were typical of open ocean water except for the fact that no eel larvae of the species *A. rostrata* or *A. anguilla* were found at Echo Bank or at any point along the entire cruise track. This project did not reveal any evidence to support the existence of Echo Bank along this cruise track at this time of year.

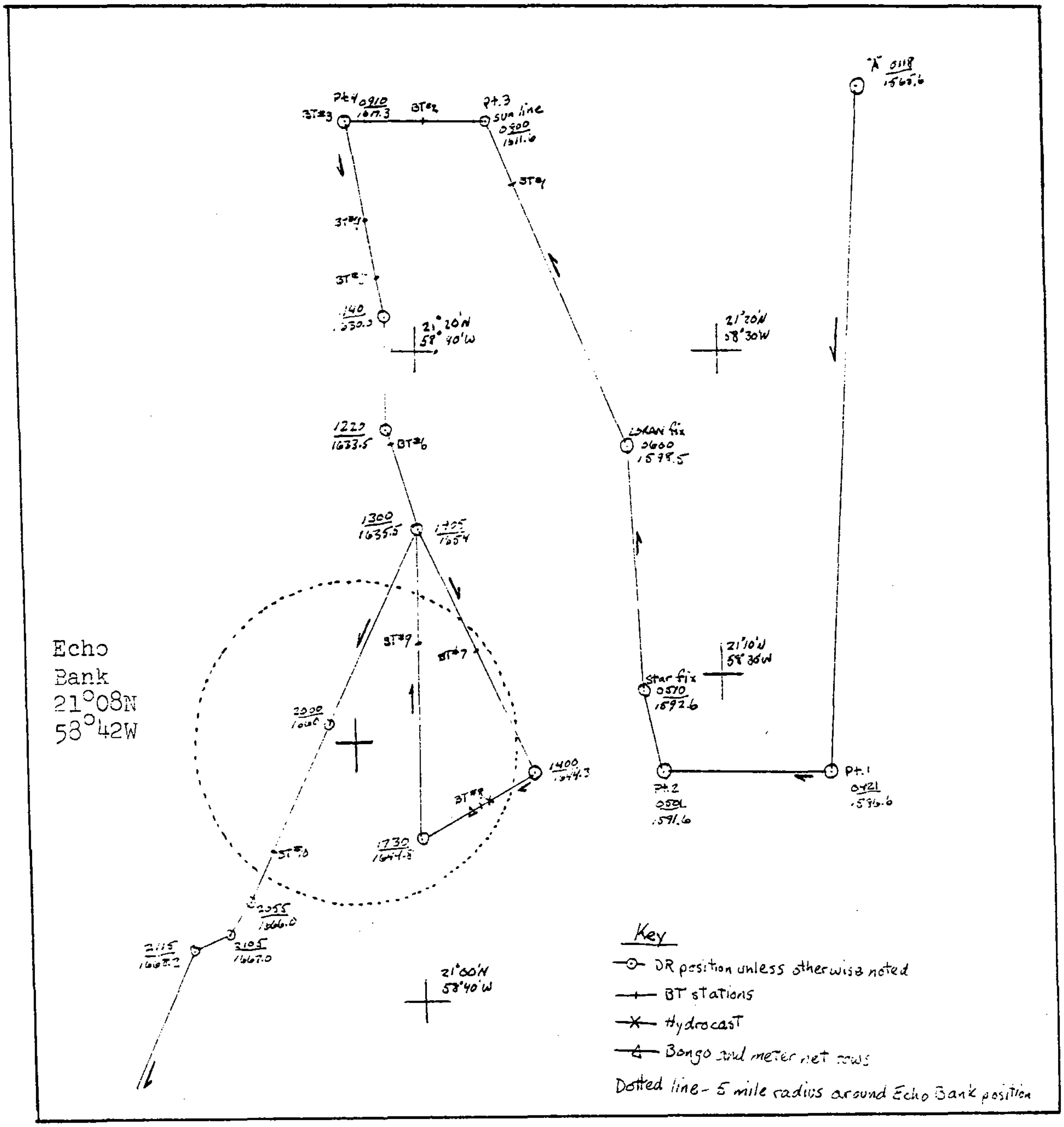


Fig. 11 Cruise track and sampling activities at Echo Bank. W-42
October 27, 1978

Oceanographic Observations in English Harbor, Antigua

Arthur Gaines, SEA Staff Scientist

The high turbidity water in two Antiguan embayments was examined as a possible consequence of anthropogenic activity. In agreement with last year's data (Gaines and Farmer, 1977, see abstract in W-36 Cruise Report) we found highest extinction in Indian Creek ($\alpha = 2.00\ m^{-1}$) a "pristine" embayment, while lower values occurred in English Harbor ($\alpha = 0.4 m^{-1}$ to $1.3\ m^{-1}$) a heavily used yachting center.

Despite torrential rainfall a week before our measurements (see "Tropical Cyclone 'Kendra,'" this report), no vertical salinity gradient was detectable and surface salinities were indistinguishable from values a year ago. This suggests very rapid export of fresh water from the embayments and from the island as well.

Net and gross productivity in English Harbor was 3 to 5 times that in Indian Creek, although respiration was about the same. The significance of this observation may become more clear when plankton samples from these sites are analysed. The dissolved phosphorus concentrations at the Harbor and Creek were 0.03 and 0.25 μML^{-1}, respectively. The differences between the embayments, in view of their other similarities, suggest they would be of considerable interest for further study.

Table 11 Results of Oceanographic Observations in Antigua Embayments, 1978.

	October 31, 1978 English Harbor Inner	Mid	Outer	November 1, 1978 Indian Creek Mid	Outer	November 7, 1978 Offshore
Water Depth (M)	3.5	-	8.0	3.5	-	800
Surface Salinity ($^{o}/oo$)	-	-	{32.2-34.0} 34.5	32.1	33.8	{34.2} 34.6
Temperature (^{o}C)	{27.6} 29.4	-	{28.5} 28.17	-	-	{27.8} 27.79
Oxygen (ml/L)	{3.9} -	-	{4.0} 4.21	{3.9} 3.97	-	{4.0} 4.20
Phosphorous (uM)	-	-	0.03	0.25	0.03	0.03
Secchi Z (a)	0.65	{3.0} -	{5.5} 4.0	{1.3} 0.70	2.8	{30.0} 30.0
Extinction (M^{-1})	1.31	-	0.40	2.00	-	0.13
% Incident on Bottom	1.0	-	4.1	0.04	-	0.00
Euphotic Zone (M)	3.5	-	11.5	2.3	-	35.4
Respiration ($mgC/M^3/hr$)	-	-20.6	-	-30.3	-	-
Net Productivity ($mgC/M^3/hr$)	-	129	-	19.2	-	-
Gross Productivity ($mgC/M^3/hr$)	-	149	-	49.4	-	-
Chlorophyll (mg/M^3)	-	-	-	0.68+0.18	-	0.07+0.005
Phytoplankton Sample	W-42/P9		W-42/P7	W-42/P8		W-42/P14

Values in { } were determined a year ago.

The Antigua-Barbuda Insular Platform

Introduction

Paul Detjen

Atlantic Ocean water moves west with the North Equatorial Current across more than 3,000 miles of deep ocean basin before encountering the lesser Antilles shallows. For a given parcel of water the passage might take from several months to more than a year, during which this water contacts neither land nor ocean bottom. Consequently, it can be assumed that some degree of chemical adjustment and biological accommodation among species is reached that reflects tropical, mixed layer, pelagic conditions.

The purpose of this program is to examine changes in the water accompanying its passage over a shallow bank -- the Antigua-Barbuda Insular Platform -- and to characterize this marine environment.

The platform is roughly rectangular in shape with the islands of Barbuda and Antigua emerging in the north and south, respectively (Fig. 12). 80% of the platform occurs at elevations above -40m and about half lies between -20 and -40m (Table 12). On the east side where slopes of nearly 10° occur the platform rises from ocean depths in excess of 2000m. To the immediate west and south sides the water depth is limited to 300 to 600 m (Fig. 12).

Considering the clarity of the water, it is reasonable to assume that sufficient light is available over as much as 80% of the platform to support positive net productivity at the bottom (Table 12). The North Equatorial Current impinges upon this landform with an average speed of 0.5 knots in a generally westward direction. The easterly trade winds and the associated waves also prevail here.

Oceanographic Observations on the
Antigua-Barbuda Platform

Summary

1. A multidisciplinary study was conducted on the Antigua-Barbuda platform to characterize this marine environment and to define modifications in ocean water accompanying its passage over the platform.
2. The geology and geography of the platform is reviewed.
3. Sediments are believed to be thin and spotty in distribution and coarse grained.
4. Current measurements show average speeds of 20 cm/sec and changes in direction of more than 90° from the prevailing ocean current.
5. Residence time of water over the platform may be as low as 3.4 days.
6. As much as 80% of the bottom probably receives sufficient light to support positive net productivity. Extinction coefficients over the platform were higher than open ocean values.
7. Hydrographic profiles suggest the upward flux of nutrients from Antarctic intermediate water is very restricted, yet elevations in certain nutrient levels over the platform and in its lee are indicated.
8. Limited zooplankton observations show 2 to 10 times as high standing stock over the platform as in the nearby open ocean.
9. The presence of floating marine grass blades indicates vegetation of the platform by these primary producers.
10. Ichthyoplankton were examined, classified and drawn.
11. The average standing crop of phytoplankton on the platform was more than an order of magnitude higher than open ocean values. Mean chlorophyll and particulate organic carbon concentrations also suggested highest levels on the platform.
12. Bird sightings over the platform recorded. Marine mammals were not seen there, but two sperm whale sightings were recorded in the passage south of Antigua.

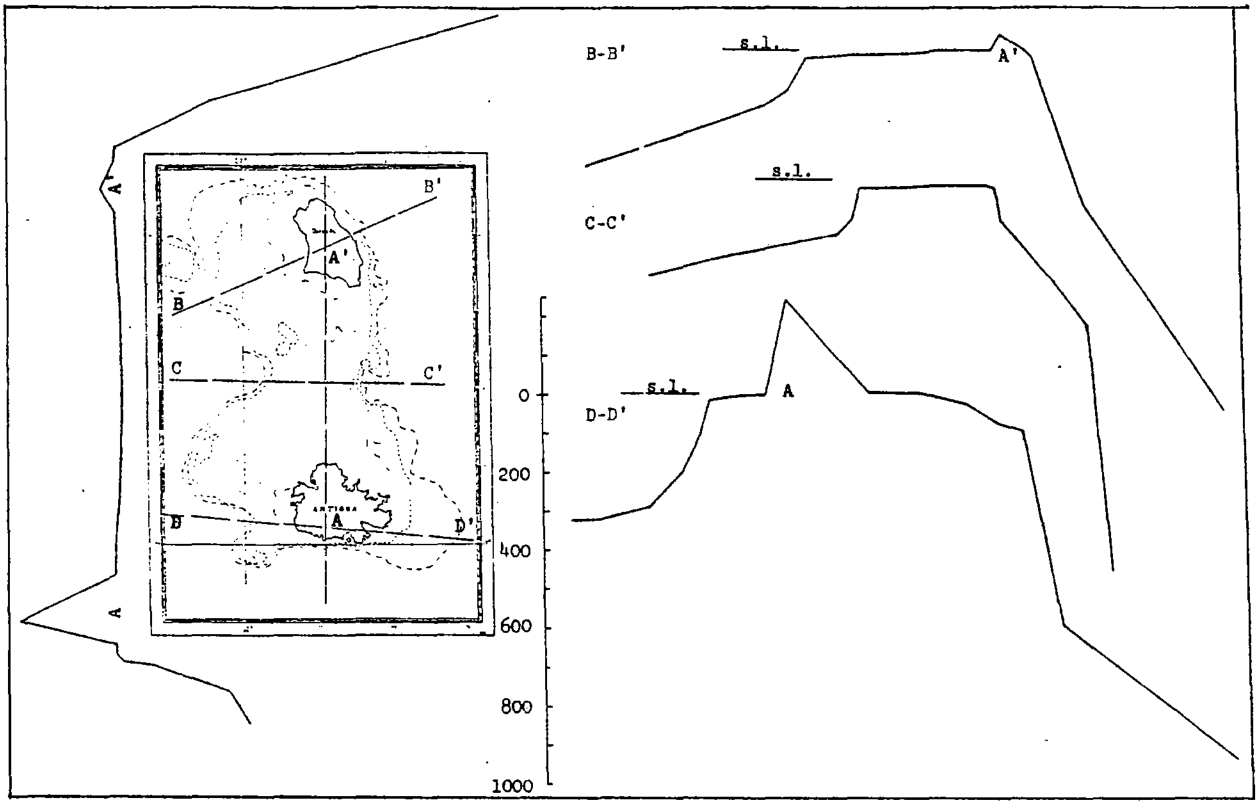


Fig. 12 Profiles of the Antigua-Barbuda Insular Platform (based on limited data from Admiralty Chart #955). Vertical exaggeration = 60.

Table 12 Approximate physiographic aspects of the Antigua-Barbuda Insular Platform

Altitude Interval (M)	Area (Km^2)		% Total		Minimum % Incident Light 1/
> 0	480		16		100
0 to -6	240		8		34
-6 to -12	40	660	1	21	12
-12 to -20	380		12		3
-20 to -40	1400		46		0.1
-40 to -200	540		18		0

1/ Using extinction coefficient of 0.18 (see Snyder, this report).

Structure of the Antigua-Barbuda Platform

Susan Humphris, Lamont

The Antigua-Barbuda platform forms part of the outer arc of the Lesser Antilles, known as the Limestone Caribbees. This ridge was constructed by submarine volcanic activity about 40–45 myrs ago, although much of it was not exposed. During the Miocene, submergence of the ridge occurred resulting in reefal growth of limestone. Uplift about 10 myrs ago, probably associated with the Andean orogeny, caused emergence of the islands exposed today (Fig. 13) and a shift in the volcanic activity to the inner arc, known as the Volcanic Caribbees.

Dredge hauls along the eastern escarpment of the Antigua-Barbuda platform [1/] have revealed the presence of pelagic sedimentary rocks rich in volcanic products. These are believed to be derived from volcanic activity during the formation of the ridge. Erosion produced volcanic detritus which slumped into the ocean. The oceanic lithosphere with this overlying sediment was later thrust beneath the arc. The sediments were scraped off and pushed against the volcanic ridge of the island arc.

Attempts to collect gravity cores on the platform during W-42 (Table 13 , Fig. 13) proved unsuccessful, apart from a few grains of coral sand, and resulted only in a bent core cutter. This suggests that the velocities of the Northern Equatorial Current prohibits the accumulation of sediment over much of the platform. A Petersen grab sample was taken in a small depression close to the centre of the platform, and this recovered coral and foram sands. The small amounts of coral sand found on the platform are probably locally derived.

1/ Fox, P.J. and Heezen, B.C., 1975. Geology of the Caribbean Crust. In A. Nairn and F. Stehli (eds): The Ocean Basins and Margins, vol. 3. The Gulf of Mexico and the Caribbean. p. 421. Plenum Press, New York.

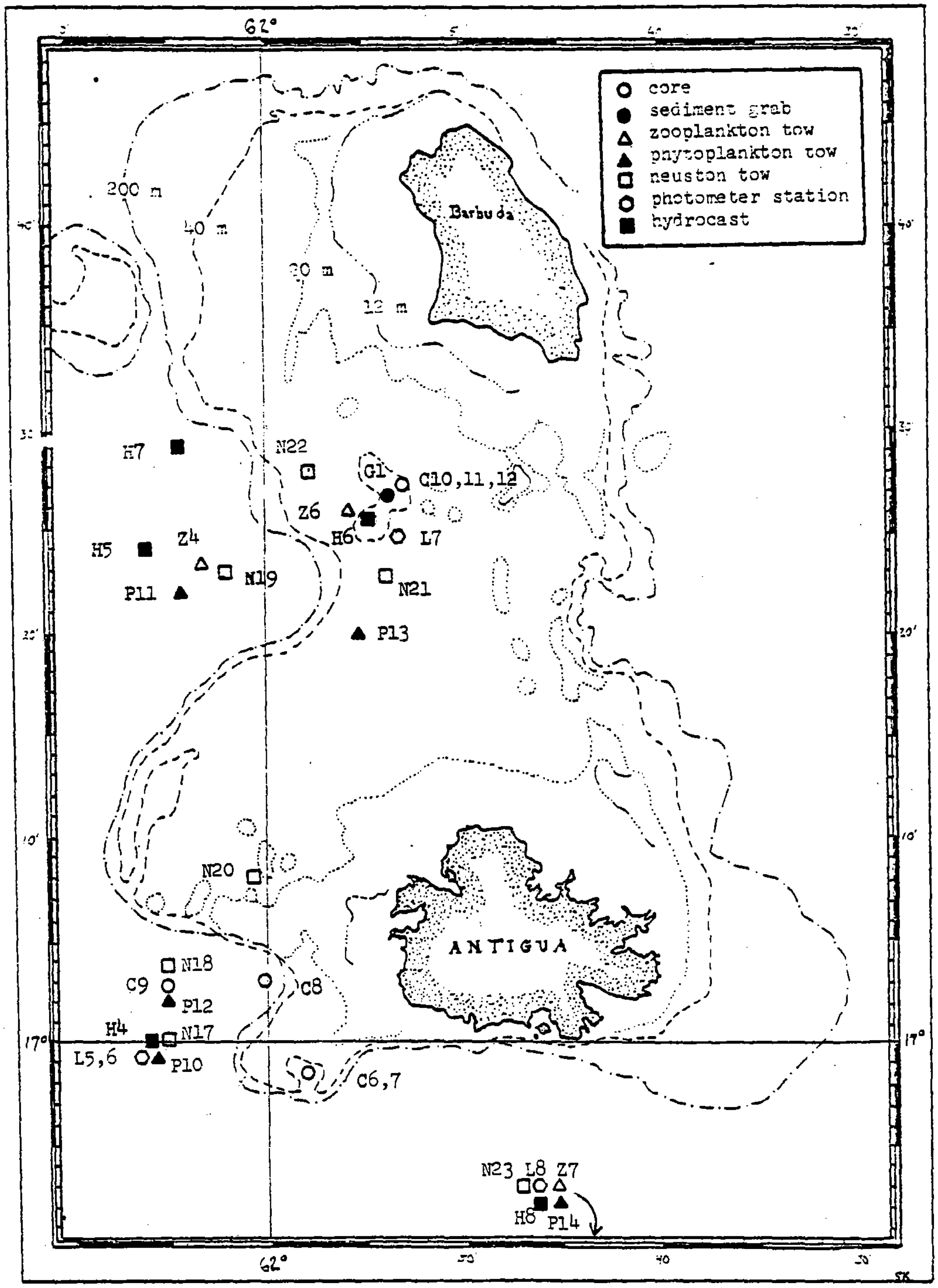


Fig. 13 Oceanographic stations on the Antigua Barbuda platform, W-42. (Base map from Admiralty Chart # 955)

Sediment of the Antigua-Barbuda Platform

Lauren Mullineaux

An analysis of the sediments of the Antigua-Barbuda Platform reveals some unexpected results. Several attempts at gravity cores were unsuccessful, either bending the core nose or bringing up very small amounts of coral sand. A Petersen grab (W-42 G-1, see Fig. 13) at one station brought up enough sandy sediment to sieve (Table 14) and examine for constituent foraminifera tests.

This sandy sediment is comprised mostly of coral, although benthonic foraminifera are also present. Very few individual planktonic foraminifera were found and these were only of the two most common species, Globigerinoides sacculifer and Globigerinoides ruber. Several factors affect the type of sedimentation on the platform. Benthonic forams are more plentiful in relatively shallow water than planktonics because the planktonics are unable to compete with the other abundant plankton. In a 0.6 knot current tests of benthonic foraminifera are more likely to be retained in the sediment than those of planktonic species for two reasons. Firstly, they are bottom dwelling organisms and secondly, their tests are larger and heavier than those of planktonic foraminifera. A major fraction of the sample is large grains because the current has winnowed out some of the small particles.

A micropaleontological slide was made of the individual types of benthonic tests, but identifications were not possible aboard ship.

Table 13 Coring and Grab Stations on the Antigua-Barbuda Platform.

Station #	Sampling Method	Location		Depth (m)	Recovery
W-42 C-6	Gravity core	$16^{\circ}58.5'N$	$61^{\circ}58.0'W$	40	Coral plug
C-7	Gravity core	$16^{\circ}58.5'N$	$61^{\circ}58.0'W$	50	Coral plug
C-8	Gravity core	$17^{\circ}03.5'N$	$62^{\circ}00.0'W$	375 mwo 1/	Empty
C-9	Gravity core	$17^{\circ}03.0'N$	$62^{\circ}05.5'W$	617 mwo	Grains of coral sand
C-10	Gravity core	$17^{\circ}27.0'N$	$61^{\circ}53.0'W$	40	Grains of coral sand
C-11	Gravity core	$17^{\circ}27.0'N$	$61^{\circ}53.0'W$	42	Grains of coral sand
C-12	Gravity core	$17^{\circ}27.0'N$	$61^{\circ}53.0'W$	34	Grains of coral sand
G-1	Petersen grab	$17^{\circ}27.0'N$	$61^{\circ}53.0'W$	40	Coralline 2/ and foram sand

1/ metres of wire out.

2/ see Mullineaux, this report.

Table 14 Textural Analysis of Sediments from the Antigua-Barbuda Platform. Sample W-42 G-1 (Table 13).

Grain Size	Percent of Total Mass
> 250μ	12.1%
150-250μ	16.3%
75-150μ	36.3%
< 75μ	35.3%

Surface Current Studies Near the Antigua-Barbuda Platform

Carol Story

A qualitative investigation of the effects of a terrestrial barrier on a major oceanic current was undertaken on the Antigua-Barbuda Insular Platform in the eastern Caribbean. The average current speed observed was 20 cm/sec. The results of the investigation show changes in the westward direction of the current of up to 128^{o} in the lee of the platform, and changes in the velocity of the current of 4-6 cm/sec. The presence of shear was also noted. It seems likely that the alteration of the flow of the current is the net result of interactions among several factors including local tidal currents, wind, sea state, and eddies.

From estimates of water volume over the platform, current speed, and the geometry of the platform, residence time of water here was estimated to be a minimum of 3.4 days.

The Penetration of Light in Seawater Near the Antigua-Barbuda Platform

James Snyder

Abstract

The penetration of light through the water column depends upon absorption and on scattering. The overall effect of these variables, referred to as extinction, was measured using a submarine photometer.

Coefficients of extinction, α, were calculated using Beer's Law ($\frac{I}{I_D} = e^{-\alpha z}$) from measurements of intensity (I) at various depths. Over a 10m pathlength coefficient of extinctions were: $0.13m^{-1}$ and $0.12m^{-1}$ in the lee of the Antigua-Barbuda platform; $0.18m^{-1}$ over the platform; and $0.07m^{-1}$ up current from the platform. An open ocean station at Echo Bank had an extinction coefficient of $0.06m^{-1}$.

These date probably indicate an increase in scattering by particles in water on and in the lee of the platform.

Hydrography of the Antigua-Barbuda Platform

Susan Humphris, Lamont

Five hydrocasts were made in the vicinity of the Antigua-Barbuda Insular Platform (Fig. 13) and one was completed on Echo Bank 250 miles N.E. of Antigua to provide a deep water station for comparison. Chemical analyses of water samples were carried out using standard techniques 1/

According to Wüst (in Fairbridge, 1966) 2/, the stratification and intermixing of four water masses control the vertical chemical variations observed in the Caribbean:

a) surface waters
b) Subtropical Underwater (SUW) with its core at 50-200m
c) Antarctic Intermediate Watter (AAIW) at 700-850m
d) North Atlantic Deep Water at 1800-2500m.

Our hydrostations reached a maximum depth of 300m (at station #5). However, several features are consistent with the larger scale distribution of water masses described by Wüst.

Our data (Fig. 14 , Appendix 4) indicate there is a seasonal temperature and salinity structure superimposed on larger scale permanent features. A surface mixed layer of 40-60m is observed on both the temperature and salinity profiles. Below this depth, the temperature decreases continuously to at least 300m. Salinity, however, increases rapidly below the mixed layer, reaching concentrations approaching 38% at station #8. This maximum lies between 60-150m and is consistent with the high salinity SUW observed by Wüst at these depths. A slight oxygen maximum evident in Fig. 14 also corresponds with the core of the SUW.

The phosphate profiles indicate the water column is depleted in this nutrient down to 250m. The increase in phosphate below this depth is probably related to the phosphate maximum associated with AAIW at depths of 700-1000m throughout the Caribbean Sea. The separation of this phosphate gradient

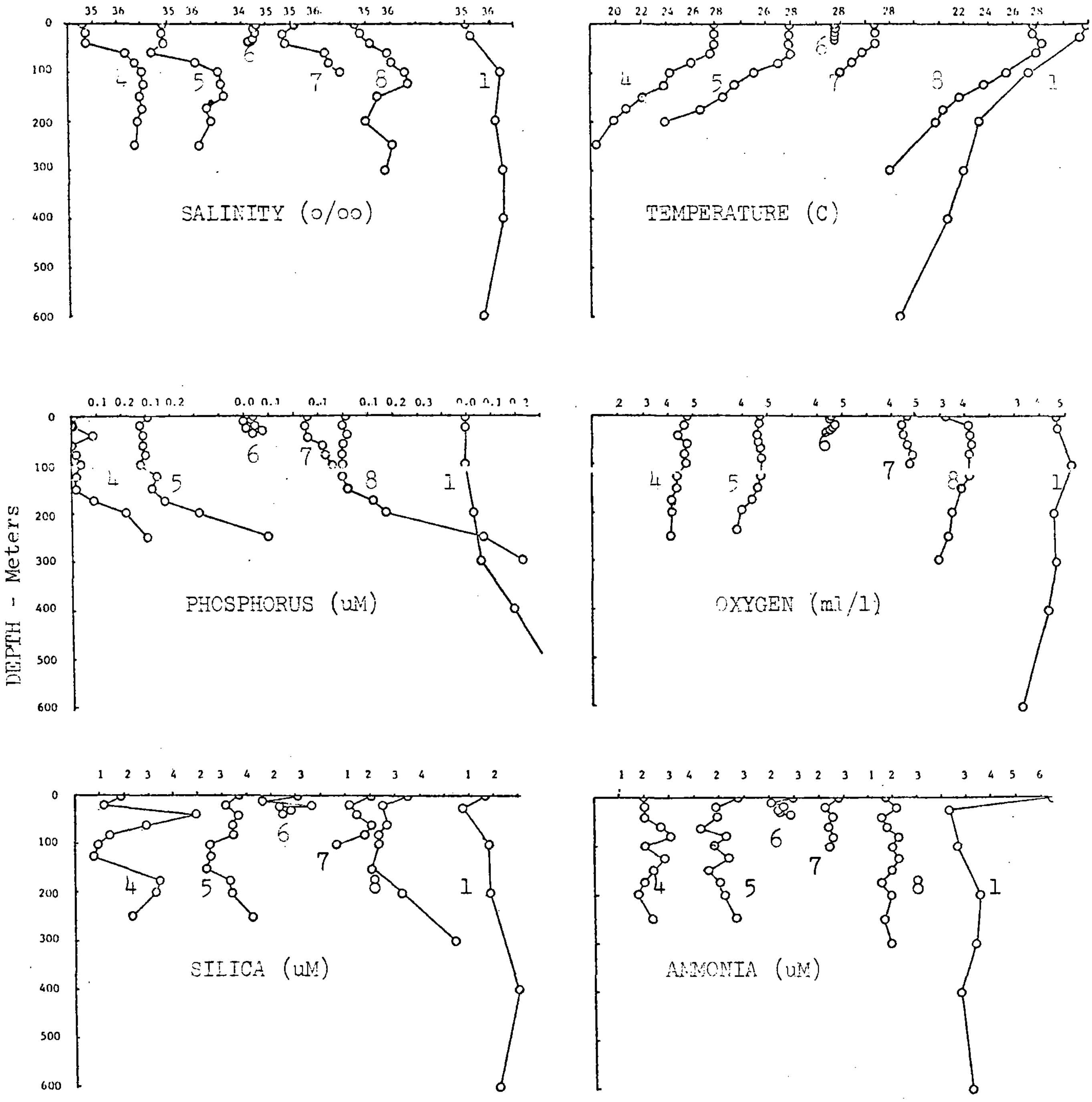


Fig. 14. Results of chemical analyses for stations on the [illegible] platform (6), in its lee (4,5,7) and up current (8). Also shown are data from Echo Bank, [illegible] miles [illegible] of Antigua (1).

from the surface mixed layer, as defined by temperature (cf. thermocline versus chemocline in PO_4) suggests that the upward flux of this element by convection is very restricted.

A second feature of the phosphate profiles is that the stations on the lee side of the platform show higher surface phosphate concentrations than those observed in deeper waters.

There is some uncertainty in the quality of the ammonia and silica data. This may stem from a problem with the shelf-life of the reagents, and suggests that weighed powders should be freshly made on board when required. First, at every station analysed, the surface concentration of silicate is higher than that at 25m. In addition, there is a minimum in the silicate profiles that corresponds to the core of the SUW. The ammonia profiles show no consistent trends.

Hydrocast #6 deserves special attention as it was the only station occupied on the platform. Samples were taken at 5m intervals in order to study the small-scale structure. The results show decreases in temperature, salinity and oxygen with depth, and an irregular increase with depth of phosphate (Fig. 13) In all cases, the absolute changes in concentration are not great, but we believe that the trends are real. At the moment, the significance of these observations is conjectural.

1/ Strickland, J.D.H. and Parsons, T.R. 1972. A Practical Handbook of Seawater Analysis. Fisheries Research Board of Canada.

2/ Fairbridge, R.W. 1966. The Encyclopedia of Oceanography. Van Nostrand Reinhold Co., New York.

Zooplankton Studies - Antigua-Barbuda Platform

Abby Ames, SEA Staff Scientist

Ten zooplankton tows (7 neuston, 3 bongo) were carried out in the vicinity of the Antigua-Barbuda Insular Platform (Fig. 13). Incomplete analyses of the samples indicate the standing stock (displacement volume) of neuston zooplankton associated with the platform is more than three times that of the open ocean in this area. The standing stock of zooplankton taken by bongo net tows between 10 and 25m (0.505mm mesh) on or in the lee of the platform ranged from 2 to 10 times that of the open ocean.

A second significant observation was the appearance of Thalassia and Syringodium blades in the neuston catch (Table 15). Concentrations of these grasses were highest near Antigua but their occurence in the mid-platform region suggests the existence of beds of these primary producers offshore as well.

Table 15 Initial Results of Neuston Tows Near the Antigua-Barbuda Platform.

Tow #	Sargassum mg/M^2	Tar balls mg/M^2	Halobates $10^3/Km^2$	Thalassia & Syringodium mg/M^2
N 17	17.6	0.65	9.7	60.
18	1.5	5.3	11.7	3.2
19	58.2	1.5	21.4	-
20	16.9	0.0	0.0	946.
21	32.4	1.2	0.6	7.1
22	77.3	1.7	11.0	-
23	0.0	5.7	12.3	-

Ichthyoplankton of the Western Tropical North Atlantic

Kathy Ashton

Abstract

Relatively very little is known about ichthyoplanton of the open ocean and of the tropics. A general survey of ichthyoplankton in the western North Atlantic Ocean and eastern Caribbean Sea was made aboard R/V Westward during W-42. Both neuston and bongo nets were used to tow for samples of larval fish that were then examined and identified by species or index and drawn for future classification.

Samples from the Antigua-Barbuda Insular Platform (W-42, Z6 and W-42, Z7, Fig. 13) were also examined for ichthyoplankton (Figs.15a and 15b , Table 16). Diversity in species of larval fish on and off the platform appears to be similar and is fairly high in both locations. The number of fish, however, seems to be greater off the platform. This may be due to increased predators, especially *Doliolid urochordates*, on the platform.

Large Fishes

Susan Dierdorff

Two forty-hook longlines, each baited with half a thawed, gutted and salted Menhaden (Pogi), were set off the Antigua-Barbuda platform near neuston stations 18 and 19 (see Fig. 13). Our only catch was a female *Prionace glauca* or blue shark approximately 6 feet long and weighing about 70 pounds. Our data may suggest problems with the bait and the great depths rather than a lack of large fishes in the area.

Table 16 Larval Fishes from Bongo Net Tows W-42/Z-6 and W-42/Z-7 at or near the Antigua-Barbuda Insular Platform.

Species	Number Z-6	Number Z-7
A	2	0
B	7	0
C	11	8
D	3	3
E	22	195
F	8	0
G	1	0
H	0	12
I	0	1
J	0	24
K	0	10
L	0	2
M	1	2
N	0	30
O	0	2
P	0	4
Q (Soleidae)	0	8
R	0	18
S	0	35
T	0	10
U	1	0
V	0	8
W	0	5
X	1	0
Y	1	0
Z	1	0
AA	1	0
BB	1	0
CC	1	0
"Pipefish" (Syngnathidae)	0	1
Flounder (Unidentified)	1	0
<u>Bothus atlanticus</u>	0	7
Eel (Muraenidae)	5	4
Eel (Ophichthidae)	0	1
Unidentified	4	137

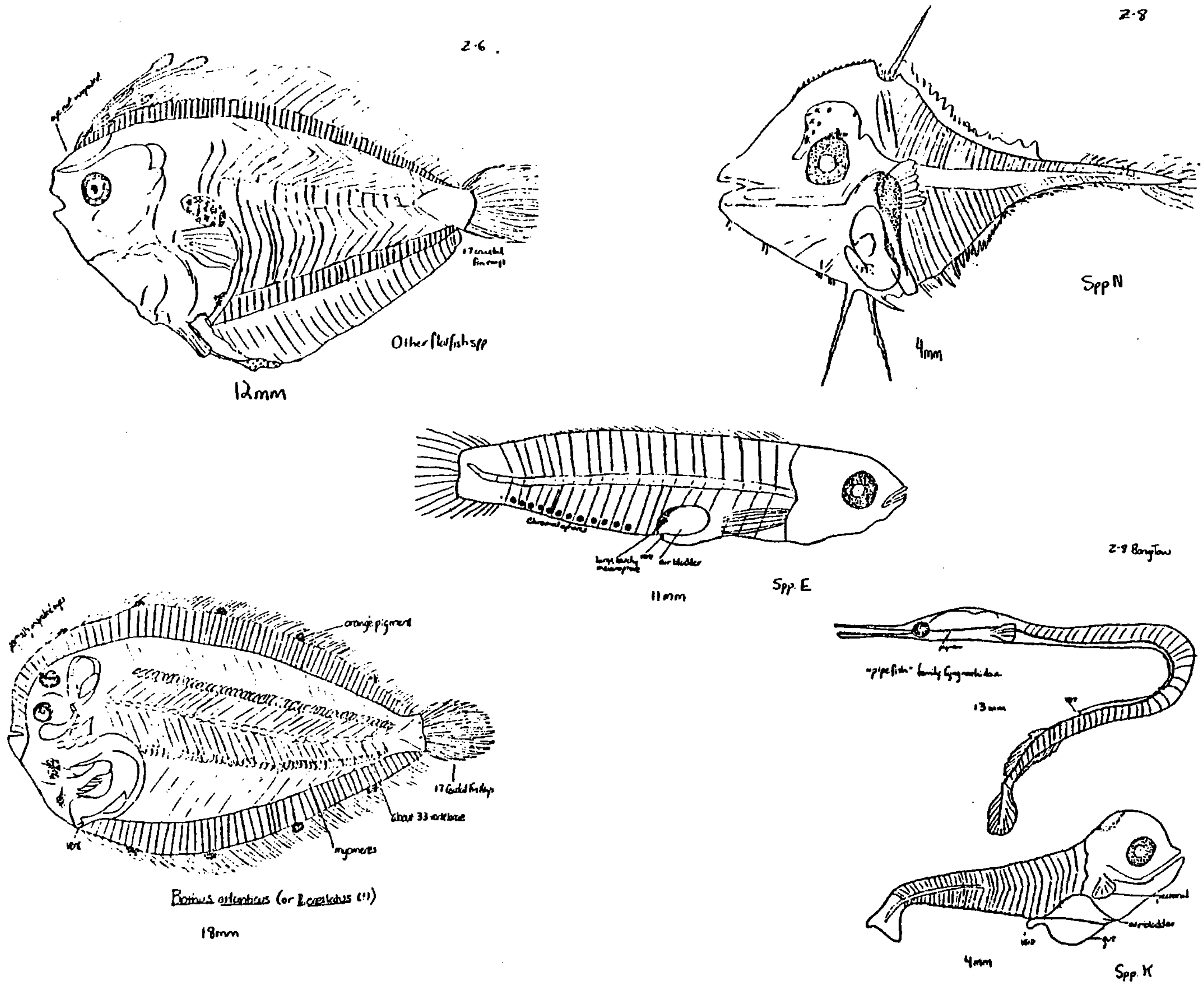


Fig. 15a Larval fishes from the vicinity of the Antigua-Barbuda platform. W-42.

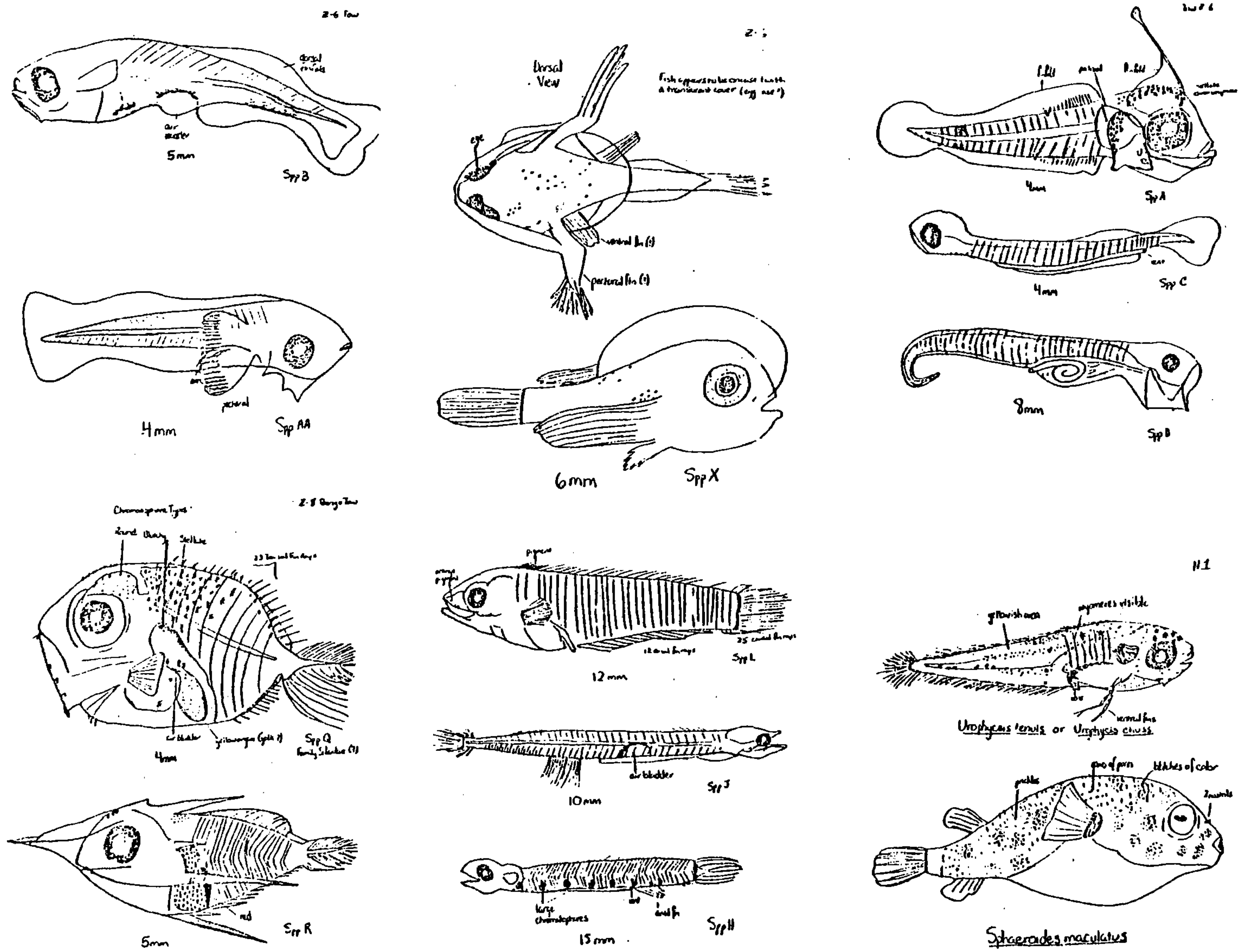


Fig. 15b Larval fishes from the vicinity of the Antigua-Barbuda platform. W-42.

Diversity and Abundance of Diatoms and Dinoflagellates in the Caribbean.

Tamsen Hermann

Abstract

Surface waters surrounding Antigua were analyzed for phytoplankton abundance and diversity. A shallow platform north of Antigua provided samples to be compared with waters to the east and west of the island. A westerly wind prevails in this area and the North Equatorial Current running westerly is strong on the windward side of the island.

The diatoms were predominant in all samples with *Chaetoceros* sp. being far more abundant than other genera, though a large diversity was found in leeward waters and on the platform (Table 17). Only two types of dinoflagellates appeared in samples: *Ceratium* sp. and *Peridinium* sp..

From these preliminary observations the average standing crop associated with the platform was 30 times that of the open sea.

Table 17 Phytoplankton from W-42 Samples on and off the Antigua-Barbuda Platform.

	W-42/P-10 cells/m^3	W-42/P-11 cells/m^3	W-42/P-12 cells/m^3	W-42/P-13* cells/m^3	W-42/P-14 cells/m^3
<u>Diatoms</u>					
Chaetoceros †	574,200	441,500	3,283	750,400	12,617
Coscinodiscus	302		138	269	280
Guinardia				68	280
Rhizosolenia	5,742	4,415	317	7,504	1,233
Eucampia		146	71		280
Frugilaria	200		34	201	
Asterionella	200	590			
Pleurosigma	100		34	133	
Thalassionema	3,022	3,680		1,273	
Nitzchia	302			68	
Navicula		140		68	
Skeletonema	200				
Leptocylindrus	65			133	
<u>Dinoflagellates</u>					
Ceratium	604	146	34	68	280
Peridinium	302				280
Total Cells/m^3	585,239	450,617	3,911	760,185	15,250
Diversity Index	.73	.36	.51	.59	.49
Latitude $^{\circ}N$	1700	1722	1702	1720	1648
Longitude $^{\circ}N$	6206	6204	6205	6155	6147
Time net in	2325	2130	0640	1912	0335
Time net out	0025	2255	0725	2007	0355
Surface Temp. $^{\circ}C$	27.9	28.0	27.8	27.8	27.8
Vol. H_2O Filtered (m^3)	22	32	34	31	12

* This sample contained many large "clumps" of material and differentiating genera or cell number was difficult.

† <u>Chaetoceros</u> sp. cells were too numerous to count in Samples 10, 11 and 13. Assuming <u>Rhizosolenia</u> sp. an accurate count this number was multiplied by 100 to get a relative approximation.

Chrolorphyll Concentrations in Surface Waters in the Vicinity of the Antigua-Barbuda Platform.

Paul Detjen

Abstract

Chlorophyll "a" determinations were made on water samples from on or near the Antigua-Barbuda insular platform using the method of Strickland and Parsons (1972).

Five samples taken on the platform and analysed in triplicate averaged 0.19 mg/M^3 in chlorophyll concentration (range of means = 0.23; standard deviation = 0.09). A single sample from station W-42 H-8 (Fig. 13) showed a concentration of 0.07 mg/M^3 which though lowest of all analyses, is not significantly lower at the 90% level of confidence. Therefore, while this study suggests a higher concentration of chlorophyll over the platform than in the open ocean, the data are by no means compelling.

Particulate Organic Carbon in Surface Water above the Antigua-Barbuda Insular Platform.

Mary Jo Wagner

Samples of water on the platform and unaffected by the platform were analysed for particulate organic carbon. The method of Strickland and Parsons was used. 1/

Five values on the platform varied from 300 to 780 mgC/M^3 and averaged 570 (standard deviation = 190). Two determinations away from the platform averaged 330 mgC/M^3 (standard deviation = 240) and therefore weakly indicate a higher level of particulate organic carbon over the platform than in the surrounding ocean.

1/ Strickland and Parsons 1972, A Manual of Sea Water Analysis.

Marine Mammal (Cetacean) Watch on the Antigua-Barbuda Insular Platform.

Thomas G. Reidenbaugh, SEA Staff Scientist

Near-continuous daylight watches were maintained in the foremast spreaders of R/V Westward during the W-42 reconnaissance of the Antigua-Barbuda insular platform, from 2 through 6 November, 1978. Lookouts searched for color changes in the water, differences in wave patterns, and major biota. No cetaceans were sighted over or adjacent to the platform. Depths over the platform were generally less than 20 fathoms, though sampling stations were also taken leeward of the platform in depths over 200 fathoms. No acoustic stations to listen for cetacean vocalizations were conducted at the platform.

Two sperm whale (*Physeter catodon*) sightings (possibly of the same individual) were recorded 6 November 1978, southwest of Antigua in the Antigua-Montserrat passage (see Miller), in depths of 400 fathoms.

Bird Sightings on the Antigua-Barbuda Platform.

Andrea D'Aquilla

Abstract

On the Antigua-Barbuda Insular Platform I made fourteen observation stations and seven individual sightings. Two Greater Shearwaters were seen on the platform for the first time since we left Bermuda. They are known to migrate through the area. The five shore species seen are common to the area and showed no variation from the other sightings in the West Indies (Table 18).

Table 18 Bird Sightings on the Antigua-Barbuda Platform W-42, 1978.

Date	Time	Species	Number
11/03	1630	Tern sp.	30
		Frigate (among tern flock)	1
11/04	1050-1100	Greater Shearwater	1
	1105-1115	-	
	1330	Greater Shearwater	1
	1500	Brown Booby	1
11/05	0820-0830	Frigate Birds	2
	1120-1130	Laughing Gull	1
		Frigate Bird	1
	1130-1140	-	
	1140-1150	-	
	1300	Tern sp.	20
	1530	Frigate	1
11/06	0830-0930	Tern sp.	2
		Gull sp.	1
	1130-1140	-	
	1215	Frigate	1
11/07	1036	Frigate	1
	1350-1400	-	
	1400-1410	-	
	1410-1420	-	
	1420-1430	Frigate	1
	1435-1445	-	
	1445-1455	-	

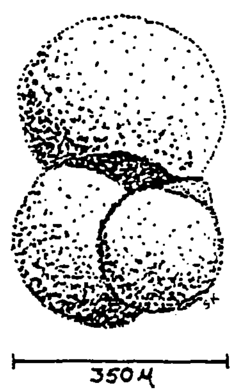
The Distribution of Recent Foraminifera in Sediment Near the West Indies.

Lauren Mullineaux

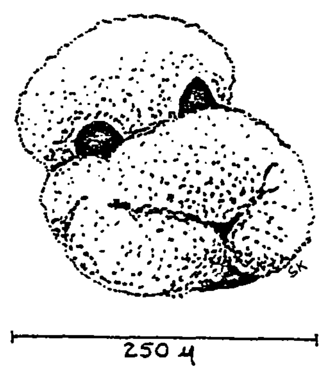
Abstract

A gravity core sample from near Guadeloupe was examined for planktonic foraminifera species and for sediment size. No significant difference in foraminifera species distribution or grain size is observed at different depths of the core. An indicator species, Globorotalia menardii is present at all depths, indicating the sedimentation rate is too high and the core too short to reach through 12,000 years of sediment to the time of the last glaciation (Table 19).

Micropaleontological slides of type specimens were prepared.



Globigerinoides sacculifer



Globigerinoides ruber.

Analysis of Guadeloupe Sediment

Table 19 A) Foraminifera from Core W-42/C-13, taken east of Guadeloupe, and
B) Sediment Size Analysis for W-42/C-13.

A)

Species of Foraminifera	Number of Species at Depth: 0-5cm	20-25cm	40-45cm	60-65cm
Globigerinoides ruber	100	116	129	110
Globigerinoides sacculifer	89	66	95	86
Globoquadrina dutertrei	34	29	19	22
Globerinella aequilateralis	12	19	16	13
Orbulina universa	28	25	6	17
Globorotalia menardii menardii	12	9	10	21
Globorotalia truncatulinoides	2	4	6	8
Globigerinoides conglobatus	8	7	6	5
Pulleniatina obliquiculata	3	4	4	4
Globorotalia tumida	2	4	0	2
Candeina nitida	5	11	9	6
Spheroidinella dehiscens	1	1	0	1
Hastigerinella digitata	3	1	0	0
Globorotalis rubescens (?)	1	1	0	1
Globorotalia menardii neoflexuosa(?)	0	3	0	1
Unknown	0	0	0	3
Benthonic	14(4.5%)	16(5.0%)	27(8.3%)	17(5.4%)
Fragments	32(9.6%)	36(10.7%)	39(11.5%)	27(8.3%)

B)

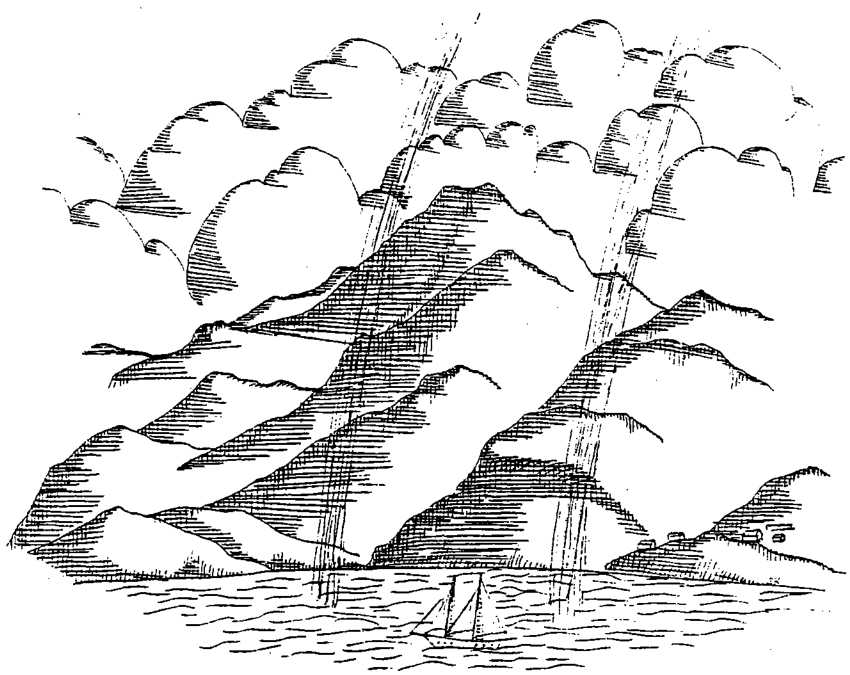
Grain Size	Percent of Total Mass at Depth: (Guadeloupe Core) 0-5cm	20-25cm	40-45cm	60-65cm	% of Total Mass (Antigua Grab) surface
> 250µ	8.6%	12.2%	8.5%	10.0%	12.1%
150-250µ	3.6%	8.1%	3.8%	5.3%	16.3%
75-150µ	14.4%	12.4%	10.6%	19.0%	36.3%
< 75µ	73.4%	67.3%	77.3%	65.7%	35.3%

Factors Affecting Sedimentation near Mount Pelée

Steven Zuckerman

Abstract

Eruptions of Mount Pelée are characterized by explosive activity and generation of volcanic ash. Pulses in sedimentation of this ash in the ocean could provide a time scale for determining sedimentation rates during intervening periods. Attempts to retrieve a gravity core on a slope of 22° on the lee side of Martinique proved unsuccessful. An angle of repose of 26° was determined experimentally for volcanic ash of size 4mm-0.025mm. This indicates that both bottom currents and bathymetric gradient play an important role in prohibiting sedimentation in this area, suggesting much of the ash may be carried offshore and deposited in the Grenada Basin.



Westward at Mt. Peleé
Martinique ~ West Indies
November 8th 1978

Observations on Planktonic Foraminifera of the Western North Atlantic

Lauren Mullineaux

Phytoplankton samples (net mesh = 69.5μ) were examined for planktonic foraminifera. Samples were taken in the Atlantic between Woods Hole and Antigua. A single slide preparation of each tow was systematically searched and species of all foraminifera present were identified and recorded (Table 20). Protoplasm was not observed in the preserved specimens. Identifications were made using Chapter 1 of Oceanic Micropaleontology (Bé, 1977).

Table 20 Planktonic Foraminifera Taken in Phytoplankton Tows on W-42.

Tow	Date	Lat north	Long west	Species	Amount
P1	10/12	41°21'	70°47'	Hasterigina pelagica	1
P2	10/13	40°31'	70°50'	Globigerinoides sacculifer	1
P3	10/14	39°50'	69°25'	Orbulina universa	1
				Globigerinoides sacculifer	2
				Globoquadrina dutertrei *	1
P4	10/17	36°37'	67°15'	Globigerinoides sacculifer	2
				Globigerinoides ruber	2
				Hasterigina pelagica	1
				Globigerinoides tenellus	1
P5	10/17	36°21'	67°15'	Globigerinoides ruber	2
				unidentified	1
P6	10/25	25°00'	58°27'	Orbulina universa	1

* has no spines

Colonial Radiolarians - A Study in Abundanc and Diversity

Jeffrey A. Platt

Abstract

The abundance and types of colonial radiolarians were studied in three regions of the ocean -- the Sargasso Sea, the Antigua-Barbuda Insular Platform and the St. Vincent Passage. Collosphaeridae and Sphaerozoidae were found in undetermined abundance in the Sargasso Sea. Collozoidae were found in the St. Vincent Passage and on the Antigua-Barbuda platform (4 Colonies/22.2 m^3) with Collosphaeridae (8 Colonies/22.2 m^3). It was found that increased currents and the presence of Trichodesmium could play an important role in the abundancy and diversity of colonial radiolarians.

Determination of the Territory Size of *Pomacentrus variabilis*

Barbara Haupt

Abstract

Seventeen speciments of damselfish (Pomacentrus) were observed in their natural habitat at the Tobago Cays to determine their territory size. A mirror was placed so that the fish could see its own reflection. The mirror was then moved until an aggressive territorial response was obtained from the fish. The distance between the positions of the mirror was then used as a measure of territory size. Territory size in five individuals averaged .27 square meters. The territory of other individuals could not be determined using this method. A non-reflective object (the reverse side of the mirror) was also placed at various positions around the fish. In all cases, no aggressive reaction was displayed toward this object.

Taffrail Fish Catch

A troll line was towed for about half of the cruise. It consisted of about 100 ft. of line with a stainless leader and a four-inch spoon (single hook, 1" gap) baited with a strip of yellow leather.

Although only three fish were caught (Table 21) many others, commonly dolphin fish and notably marlin (?) were sighted. This suggests some attention to the finer points of angling could appreciably improve the catch.

Table 21 The Taffrail Fish Catch for W-42

Date	Time (local)	Species	Length (cm)	Weight (Kg)
10/25	1030	Unknown. A mackerel resembling *Scombesomorus cavalla* but the lateral line dropped sharply near the mid *first* dorsal	77.5	1.9
10/29	0650	Dolphin (*Coryphaena hippurus*)	71.0	3.5
10/29	0933	Dolphin (*Coryphaena hippurus*)	59.0	1.8

Processing Ektachrome Color Slide Film Aboard *Westward*

Toby Claus

Abstract

Ektachrome color slide film can now be routinely processed aboard *Westward*. During W-42, twelve rolls of 20-exposure Ektachrome slide film were processed, all with excellent results. The process takes approximately one hour from start to finish for each roll developed. Processing slides on board the ship makes it possible for a complete and accurate visual record of scientific research, general shipboard activities and shore experiences to be assembled and used during the cruise.

The materials used include a Unicolor E-6 developing kit, a 16 oz. developing tank, Ektachrome color slide film: ASA 64 or 200, and the ship's tap water for mixing chemicals and washing the film. All necessary equipment was stored directly in a specially compartmented insulated camper cooler which served as the basic container and thermostatic bath for the process. Five gallons of preheated rinse water is stored in an insulated drink dispenser.

Sightings of marine mammals were photographed, as well as some microscopic slide work. These were stored for future reference to be used on subsequent cruises. In the case of whale sightings, these slides may be of great importance, where the identification of an individual is possible on the basis of fin and fluke markings.

Evaluation of the Bait Bucket for Fish Identification and Population Estimates

Daniel Tierney

Abstract

The usual method associated with the bait bucket involves the use of a camera for observations. A modification of this technique has allowed observations to be carried out by an observer located at the surface. Observations were done in the Tobago Cays area by using the avon, snorkeling gear, and a bait bucket. Due to limited observations no conclusive statements can be made.

Measuring Polynesian Navigation in the Caribbean

Charles Zechel

Abstract

Cloud, wind, wave and swell were measured to investigate their use in Polynesian methodology of practicing navigation, and to determine whether this methodology has application in the area of the Windward Islands of the Caribbean. The close proximity of the islands to each other and different characteristics inherent to a sea as compared to an ocean show that while the methodology is not transferable to the Caribbean, it undoubtedly would function well in the Pacific.

Methodology in Collecting Colonial Radiolarians

Jeffrey A. Platt

A slow tow filtering a large amount of water is imperative. Use a collecting jar on the net of the largest volume possible. A meter net just at the surface while the ship is "hove to" seems to be an acceptable method. The colonies must be counted immediately upon retrieval. This can be accomplished by using either a small Petri dish or the "blunt" end of a Pasteur pipette to transfer the colonies from the sample into the vials. Human contact should be avoided and the fewer times the colonies are transferred, the better the condition of the colonies will be. Preservative is then added to the vials -- Picric acid saturated in 4% non-buffered formalin in a 1 to 1 ratio with sea water. After a period of about 1 day, the Picric acid solution can be replaced by ethanol. 1/

1/ Mr. Neil Swanberg, Woods Hole Oceanographic Institution, Oral Communication.

ACKNOWLEDGEMENTS

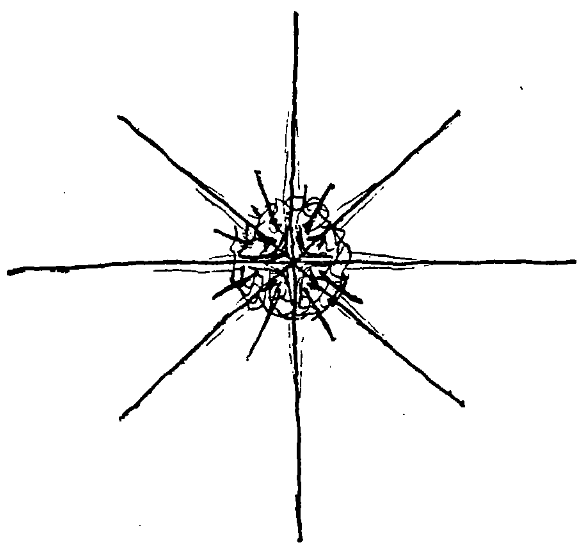
On behalf of the scientific staff and students of W-42, I wish to thank the Captain, Rick Farrell, for his cooperation during the cruise. The assistance of Dr. John Markham of the Bermuda Biological Station and Mr. Desmond Nicholson of the Antigua Archeological Society is gratefully acknowledged.

Research clearances for parts of W-42 were granted by the State of St. Vincent; the State of St. Lucia; Martinique (France); the State of Dominica; Monserrat; and the State of Antigua.

The report was typed as a result of the tireless effort of Judy Fenwick.

- Arthur G. Gaines, Jr.

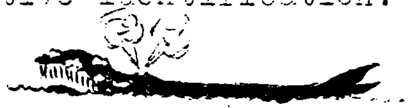
APPENDICES



APPENDIX 1. Final Examination Essay Questions.

(Answer A - 1 or 2 from B + 1 or 2 from C; ie. A + 3 others.)

A. You sight this whale in the northern Caribbean and immediately make a positive identification. What is it? How do you know?



B. You have observed the use of several kinds of nets (filtering devices) aboard Westward. What problems are associated with concentrating organisms or particles using nets?

Outline the basic special characteristics of three kinds of nets and the purpose of these special features.

B. A vast plume of municipal effluent flows seaward from a point-source outfall along the coast, differing from adjacent seawater in surface wave height and wave orientation, color, light penetration, suspended sediments, density, temperature, and salinity, and creating an algal bloom.

Briefly describe how you might use one airborne system and one satellite system to remotely sense some of these aspects. What information would each provide you, and how would you validate that information?

B. In most laboratory methods there are certain steps which require the utmost of precision and others for which extreme precision adds nothing to the accuracy or precision of the method.

Using either the O_2 or the salinity analysis as an example discuss this statement.

C. Discuss the nature of thermohaline circulation between a salt wedge (poorly-mixed) estuary and the ocean. How is this pattern of significance to marine organisms and to the exchange of particles and nutrients?

C. For oxygen and one other nutrient element in the ocean, discuss briefly (a) the analytical technique, and (b) factors affecting the distribution of the element in the water column.

C. The ocean is variously portrayed in literature and the media. During this cruise we have observed first-hand many characteristics of the ocean surface, and through our instruments, sensed aspects of the deep sea. In rigorous scientific terms discuss how your view of the ocean as a biological, physical, and/or chemical environment has changed as a result of this experience (ie. what aspects of the ocean environment surprised you?).

APPENDIX 1. (Continued). Final Examination Essay Questions.

C. Discuss aspects of the structure and geology of the Lesser Antilles and how these relate to larger-scale geological processes.

Appendix 2. Demonstration organisms used as a basis for the practical exam.

Phylum Chordata

Thalia democratica	Salp
Puffins gravis	Greater Shearwater
Cypselurus heterurus	Flying Fish
Stenella plagiodon	Atlantic Spotted Dolphin
Anguilliform Muraenidae	Eel larva

Phylum Chaetognatha

Sagitta elegans	Arrow Worm

Phylum Ctenophora

Pleurobranchia pileus	Comb Jelly

Phylum Arthropoda

Halobates micans	Water Strider
Panulirus larva	Spiny Lobster Larva
Nematoscelio tenella, _N. microps_	Assorted Euphausiids

Phylum Mollusca

Calliteuthis reversa	Pelagic Squid

Phylum Echinodermata

Echinaster sentus	Thorny Starfish

Phylum Protozoa

Homotrema rubum	Foramimiferida

Division Phaeophycophyta

Sargassum fluitans/natans	Sargassum Gulfweed

Phylum Cyanophyta

Tricodesmium	Blue-green Algae

Appendix 3. Bathyothermograph Stations W-42

#	Date	Time	North Latitute	West Longitude	Surface Temp.(C)
W-42/1	10/27	0715	21 25'N	58 37'W	28.0
2	10/27	0814	21 27'	58 39'	28.0
3	10/27	0924	21 27'	58 39'	28.0
4	10/27	1040	21 24'	58 42'	27.8
5	10/27	1123	21 23'	58 42'	27.9
6	10/27	1231	21 17'	58 42'	27.9
7	10/27	1339	21 11'	58 38'	27.9
8	10/27	1615	21 05'	58 38'	27.8
9	10/27	1822	21 11'	58 40'	27.7
10	10/27	2046	21 05'	58 45'	27.9
11	11/02	1815	16 55'	61 58'	27.9
12	11/03	2246	17 30'	62 18'	28.0
13	11/07	0115	16 48'	61 48'	27.8
14	11/07	0742	16 13'	61 51'	27.3
15	11/07	1055	16 14'	62 52'	28.5
16	11/07	1515	16 09'	61 54'	28.7
17	11/08	0758	15 15'	61 26'	27.2
18	11/08	1000	15 06'	61 29'	28.2
19	11/08	1700	14 45'	61 13'	28.0
20	11/08	2314	14 14'	61 03'	27.0
21	11/12	1800	13 49'	61 12'	28.1
22	11/13	1315	13 28'	61 25'	28.9
23	11/13	1400	13 28'	61 25'	28.9

Appendix 4. Summaries of W-42 Hydrocast Data

W-42/H1 (Echo Bank) October 27, 1978; 15^{26}; 21°06'N, 58°38'W

Wire Out (M)	Thermometric Depth (M)	Temp (°C)	Sal (tit) (o/oo)	Sal (Opt) (o/oo)	O_2 (ml/L)	PO_4 (µM/L)	$Si(OH)_4$ (µM/L)	NH_3 (µM/L)
0(B)	0	27.9(B)	35.09	34.9	4.74	b.d. 1/	1.70	6.47
25	24	27.30	35.32	36.5	4.75	b.d.	0.80	2.42
100	97	23.35	36.54	37.3	5.35	b.d.	1.88	2.68
200	193	19.33	36.25	36.9	4.63	0.03	1.92	3.58
300	290	18.06	36.59	36.9	4.78	0.06	0.63	3.40
400	387	16.83	36.55	36.5	4.42	0.19	3.11	2.82
600	580	12.88	35.77	35.7	3.40	0.43	2.29	3.19

W-42/H4 (Antigua-Barbuda Platform) November 2, 1978; 23^{36}; 17°00'N, 62°06'W

Wire Out (M)	Thermometric Depth (M)	Temp (°C)	Sal (tit) (o/oo)	Sal (Opt) (o/oo)	O_2 (ml/L)	PO_4 (µM/L)	$Si(OH)_4$ (µM/L)	NH_3 (µM/L)
0		27.95	34.61		4.78	0.01	1.91	1.98
20		27.92	34.69		4.67	b.d.	1.19	2.04
40		27.94	34.69		4.40	0.09	4.99	2.03
60		27.65	36.29		4.78	b.d.	2.94	2.73
80	82	26.06	36.67		4.71	0.02	1.37	3.07
100	103	24.37	36.98		4.73	0.04	0.97	2.04
125		23.85	37.02		4.39	0.02	0.77	2.85
150		22.08	36.86		4.38	0.02	–	2.42
175	177	20.74	36.96		4.23	0.09	3.50	2.01
200		19.90	36.82		4.17	0.22	3.34	1.81
250		18.50	36.72		4.15	0.31	2.31	2.48

W-42/H5 (Antigua-Barbuda Platform) November 4, 1978; 00^{25}; 17°24'N, 62°06'W

Wire Out (M)	Thermometric Depth (M)	Temp (°C)	Sal (tit) (o/oo)	Sal (Opt) (o/oo)	O_2 (ml/L)	PO_4 (µM/L)	$Si(OH)_4$ (µM/L)	NH_3 (µM/L)
0	(0) 2/	27.92	34.85		4.69	0.11	3.72	2.77
20	(18)	27.92	34.80		4.68	0.08	3.20	1.93
40	31 (36)	27.93	34.92		4.62	0.09	3.66	2.00
60	(55)	27.95	34.40		4.65	0.09	3.48	1.38
80	68	27.11	36.16		4.71	0.10	3.50	2.30
100	91	25.14	37.10		4.81	0.08	2.56	1.85
125	(125)	23.64	37.18		4.77	0.15	2.61	2.37
150	148	22.58	37.32		4.65	0.13	2.44	1.62
175	(171)	20.76	36.57		4.37	0.18	3.36	2.06
200	(194)	(?)24.97	36.78		4.08	0.32	3.48	2.25
250	233	17.96	36.32		3.80	0.60	4.27	2.72

Wire Out (M)	Thermometric Depth (M)	Temp (^{O}C)	Sal (tit) (o/oo)	Sal (Opt) (o/oo)	O_2 (ml/L)	PO_4 (µM/L)	$Si(OH)_4$ (µM/L)	NH_3 (µM/L)
W-42/H6 (Antigua-Barbuda Platform) November 5, 1978; 18^{15}; 17^{O}27'N, 61^{O}54'W								
0		27.77	34.69		4.60	0.04	3.06	2.96
10		27.78	34.53		4.53	b.d.	1.72	2.14
20		27.70	34.59		4.70	0.05	3.72	2.62
25		27.73	34.51		4.58	0.01	2.40	2.37
30		27.72	34.53		4.51	0.08	2.84	2.52
35		27.72	34.30		4.27	0.04	2.51	2.85
W-42/H7 (Antigua-Barbuda Platform) November 6, 1978; 00^{35}; 17^{O}29'N, 62^{O}04'W								
0		27.80	35.16		4.71	0.06	2.04	2.77
20	27	27.82	34.74		4.43	0.05	1.23	2.28
40		27.89	34.76		4.46	0.06	1.49	2.63
60	62	26.77	36.39		4.66	0.12	2.10	2.40
80		26.49	36.57		4.94	0.13	1.83	2.56
100	101	25.06	37.04		4.84	0.16	0.66	2.49
W-42/H8 (Antigua Guadeloupe Channel) November 6, 1978; 23^{20}; 16^{O}48'N, 61^{O}47'W								
0	-	27.79	34.62		3.28	0.01	3.50	1.75
20	-	27.81	34.80		4.19	b.d.	2.52	2.23
40	42	28.30	35.16		4.23	0.02	-	1.56
60	-	27.93	35.90		4.29	b.d.	2.67	1.79
80	-	-	36.05		4.20	b.d.	2.35	2.32
100	92	25.48	36.61		(?)3.75	b.d.	2.42	2.04
125	-	23.71	36.67		4.24	b.d.	-	2.25
150	-	21.69	35.51		3.90	0.02	2.10	2.00
175	179	20.39	38.02(?)		2.10	0.12	-	1.56
200	-	19.77	35.02		3.55	0.17	3.31	1.96
250	-	-	36.07		3.38	0.57	-	1.68
300	309	16.02	35.75		2.99	0.73	5.49	1.94

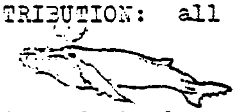
1/ b.d. = below limit of detection.

2/ value in ( ) is determined by interpolation.

Appendix 5. Check list for Cetacean identification. T. Reidenbaugh.

SPERM WHALE 30-60 ft
BLOW: 45° to front left; 8 ft

COLOR: v. dark above, lighter below; no white markings
BODY SHAPE: square head 1/3 body length; dorsal hump followed by bumps; wrinkled skin
FIN: no fin--dorsal hump instead
FLUKES: broad, triangular, smooth edges, deep notch
FLIPPERS: blunt, rounded
DIVING: back arched, flukes out (deep dive)
BEHAVIOR: solitary, or small to v. large pods; wary
DISTRIBUTION: all temperate and tropical



HUMPBACK 50 ft
BLOW: low & bushy

COLOR: dark above, white on belly, flippers mostly white, flukes some
BODY SHAPE: stout body, v. long flippers; knobs on head and jaw
FIN: small dorsal fin on hump, slightly hooked
FLUKES: irregularly scalloped behind
FLIPPERS: extremely long (1/3 body length), knobby
DIVING: back v. arched, flukes out
BEHAVIOR: solitary or sm. pods; jump, roll, headstand, tail-slap
DISTRIBUTION: tropics to arctic

RIGHT WHALE 50 ft
BLOW: low, bushy, V-shaped

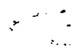
COLOR: all dark (white callosities)
BODY SHAPE: v. stout and round; arched mouth; callosities on head
FIN: none
FLUKES: broad, pointed, smooth
FLIPPERS: v. blunt, short
DIVING: back arched, flukes out
BEHAVIOR: sluggish
DISTRIBUTION: arctic to Florida; rare

RORQUALS (OVER) Blue, Finback, Sei, Bryde's, Minke 30-85 ft
BLOW: vertical

COLOR: variable
BODY SHAPE: long, streamlined
FIN: approx. 2/3 back body, v. slightly to strongly hooked
FLUKES: streamlined
FLIPPERS: short, smooth
DIVING: variable
BEHAVIOR: fast-swimming

(top)  BLUE WHALE 85 ft
BLOW: to 30 ft

COLOR: blue-grey overall, light spots on sides and back, no white
BODY SHAPE: head broad, flat, U-shaped; 1 ridge from snout to blowhole
FIN: small (8-13"), triangular to slightly hooked, at least 2/3 back
DIVING: back v. slightly arched, only rorqual which may raise flukes
BEHAVIOR: single or pairs; fin appears well after blow
DISTRIBUTION: polar to tropics; rare

 FINBACK 70 ft
BLOW: 15-20 ft

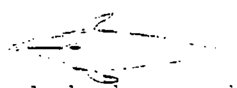
COLOR: dark above, light below; right lips & right front baleen white
BODY SHAPE: head flat, V-shaped; 1 ridge from snout to blowhole
FIN: high (14-21"), moderately hooked, front edge less than 40°; slightly less than 2/3 back
DIVING: does not raise flukes; rises sharply--snout may break surface
BEHAVIOR: sm. or lg. pods; fin appea rs shortly a fter blow
DISTRIBUTION: polar to Florida, rare in tropics

 SEI WHALE 60 ft
BLOW: to 15 ft

COLOR: dark above, light below; light spots on sides but not back
BODY SHAPE: head slightly arched, between U- and V-shaped; 1 ridge
FIN: v. high (10-28"), strongly hooked, front edge more than 40°; less tha n 2/3 back
DIVING: does not arch back or raise flukes; surfaces shallow
BEHAVIOR: sm. pods; head & fin a ppear at same time
DISTRIBUTION: polar to tropics

 BRYDE'S WHALE 45 ft
BLOW: ?

COLOR: dark overall
BODY SHAPE: head between U- and V-shaped; 3 ridges from snout to blowhole
FIN: high (18"), strongly hooked; jagged rear edge; less than 2/3 back
DIVING: does not raise flukes; surfaces steeply
BEHAVIOR: ?
DISTRIBUTION: temperate to southern tropical

 MINKE WHALE 30 ft
BLOW: ?

COLOR: dark above, w hite below; white band on flippers
BODY SHAPE: head v. V-shaped; pointed; 1 ridge from snout to blowhole
FIN: 12" high, smooth & hooked; slightly less than 2/3 back
DIVING: does not arch back or raise flukes
BEHAVIOR: single, pairs or trios; head & fin appear at same time; curious about ships; may leap
DISTRIBUTION: polar to tropics

SHORT-FINNED PILOT WHALE 18 ft

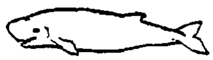
COLOR: all black, except grey on chin & belly
BODY SHAPE: head bulbous, thick, may be flattened in front; body thick just ahead of flukes
FIN: far forward on back; v. broad base, hooked & rounded
BEHAVIOR: sm. to v. lg. pods; may leap, head-stand, tail-stand
DISTRIBUTION: Virginia to Caribbean

GRAMPUS 13 ft

COLOR: lt. grey to black above, lt. below; lt. scars all over body; fin, flukes, & flippers dk., head may be all white
BODY SHAPE: thick body; blunt, bulbous head; crease in front of head
FIN: mid-back, tall (15"), hooked, pointed
BEHAVIOR: v. lg. pods; may leap, "porpoise", ride bow wave
DISTRIBUTION: temperate & tropical

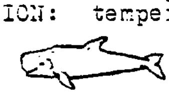
PYGMY KILLER WHALE 9 ft

COLOR: dk. grey above, lighter on sides (esp. in front of fin), some w hite on belly, white around lips, chin may be white
BODY SHAPE: slender body, round head
FIN: mid-back, 8-12", hooked, may be pointed
FLIPPERS: rounded; front edge does not bend back sharply near middle
BEHAVIOR: lg. pods
DISTRIBUTION: tropics & subtropics



PYGMY SPERM WHALE 13 ft

COLOR: dk. grey above, lighter below
BODY SHAPE: forwa rd-slanting square head, blowhole on top not front; sm. lower jaw; false "gill slits"
FIN: small, hooked, more than 1/2 back
BEHAVIOR: folds flippers against body when swimming
DISTRIBUTION: temperate to northern tropics



DWARF SPERM WHALE 9 ft

COLOR: dk. above, lt. below
BODY SHAPE: square head, small lower jaw, false "gill slits"
FIN: mid-back, tall, hooked
DISTRIBUTION: temperate to northern tropics

GOOSEBEAKED WHALE 23 ft
BLOW: faint, forward

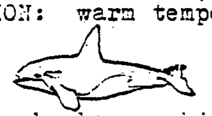
COLOR: dk. above, lt. below; lt. blotches on belly; head may be lt.
BODY SHAPE: no real beak, head backward sloping & slightly concave, indentation on back behind head
FIN: 15", hooked, smooth
FLUKES: v. slightly notched
BEHAVIOR: pods 10-25; may jump
DISTRIBUTION: temperate & tropical

ANTILLEAN BEAKED WHALE 22 ft

COLOR: dk. above, lt. below
BODY SHAPE: beaked, slender, indentation on back behind head
FIN: small
FLUKES: not notched at all
DISTRIBUTION: New York to Caribbean

DENSE-BEAKED WHALE 17 ft

COLOR: dk. above, lt. below; may be blotched with grey-white, often scarred; flippers lighter then back
BODY SHAPE: beaked, sharp rise at rear lower jaw; body tapered both ends
FIN: small
FLUKES: seldom notched, may bulge at mid-point
DISTRIBUTION: warm temperate



KILLER WHALE 30 ft

COLOR: black above; white on belly, sides behind fin, patch behind eye
BODY SHAPE: chunky body, round head; extremely high fin
FIN: to 6 ft & erect; or to 3 ft & curved
FLIPPERS: paddle-shaped, round
BEHAVIOR: sm. to v. lg. pods; fast; may leap, tail-stand
DISTRIBUTION: arctic to rare in tropics

FALSE KILLER WHALE 18 ft

COLOR: all black, except for grey on belly between flippers
BODY SHAPE: head narrow, tapered forward; teeth may be visible
FIN: mid-back, 7-16", slender, hooked, may be pointed
FLIPPERS: front edge sharply bends back near middle
BEHAVIOR: v. lg. pods; may jump, ride bow waves
DISTRIBUTION: tempera te & tropical

ATLANTIC SPOTTED DOLPHIN 7.5ft.

COLOR: lt. spots on dk. above, dk. spots on lt. below; white on lips and tip of beak; dk. high on back
BODY SHAPE: robust; narrow head
FIN: distinctively hooked
BEHAVIOR: pods 5-50; bow wave riders; breeches
DISTRIBUTION: temperate & tropical; deep waters

BRIDLED DOLPHIN 7ft.

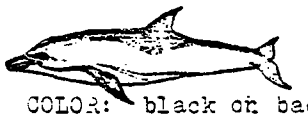
COLOR: lt. spots on dk. above, dk. spots on lt. below; dk. cape on top of head; black stripe from flippers to mouth; black around eyes
BODY SHAPE: short beak
FIN: distinctively hooked; pointed
BEHAVIOR: pods 5-50; occasionally rides bow waves
DISTRIBUTION: tropical & subtropical; replaces Spotted Dolphin in the low latitudes

SPINNER DOLPHIN 7ft.

COLOR: dk. on back, gray or yellow on sides, white on belly; black lips & tip of snout; black stripe from flipper to eye
BODY SHAPE:- slender; long snout
FIN: tall & triangular; back tilted
BEHAVIOR: pods up to 100; loves to breech; rides bow waves; when breeches will spin longitudanally
DISTRIBUTION: tropical

STRIPED DOLPHIN 9ft.

COLOR: blue-gray on back, white on belly, distinctive black stripe from eye to anus running along side of body; black stripe from eye to flipper
BODY SHAPE: streamlined; short snout
FIN: tall & triangular & back tilted
BEHAVIOR: pods up to 100; breeches; occasionally rides bow waves

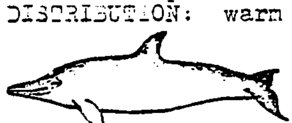


SADDLEBACK DOLPHIN 8FT.

COLOR: black on back, white belly,; hourglass pattern on sides made up of 2 yellow-tan ellipses; black line from flipper to snout
BODY SHAPE: streamlined; intermediate snout length
FIN: triangular to hooked; pointed
BEHAVIOR: pods up to 100; loves to breech; rides bow waves
DISTRIBUTION: temperate & tropical

ATLANTIC BOTTLED NOSED DOLPHIN 12ft

COLOR: dark gray on back fading to white on belly;
BODY SHAPE: large hea d; short stubby snout
FIN: tall & hooked; broad based
BEHAVIOR: pods of 10-50; loves to breech and ride bow waves
DISTRIBUTION: warm temperate and tropical; coastal waters



ROUGH TOOTHED DOLPHIN 8ft

COLOR: dk. on back fading to white on belly; white along sides of snout; white on flippers
BODY SHAPE: long slender snout; head appears long and conelike
FINS: hooked
BEHAVIOR: pods 5-50; bow wave rider
DISTRIBUTION: warm temperate & tropical