CRUISE REPORT

W-37

Scientific Activities

San Juan - Miami

November 30, 1977 - January 11, 1978

R/V WESTWARD

Sea Education Association

Woods Hole, Massachusetts

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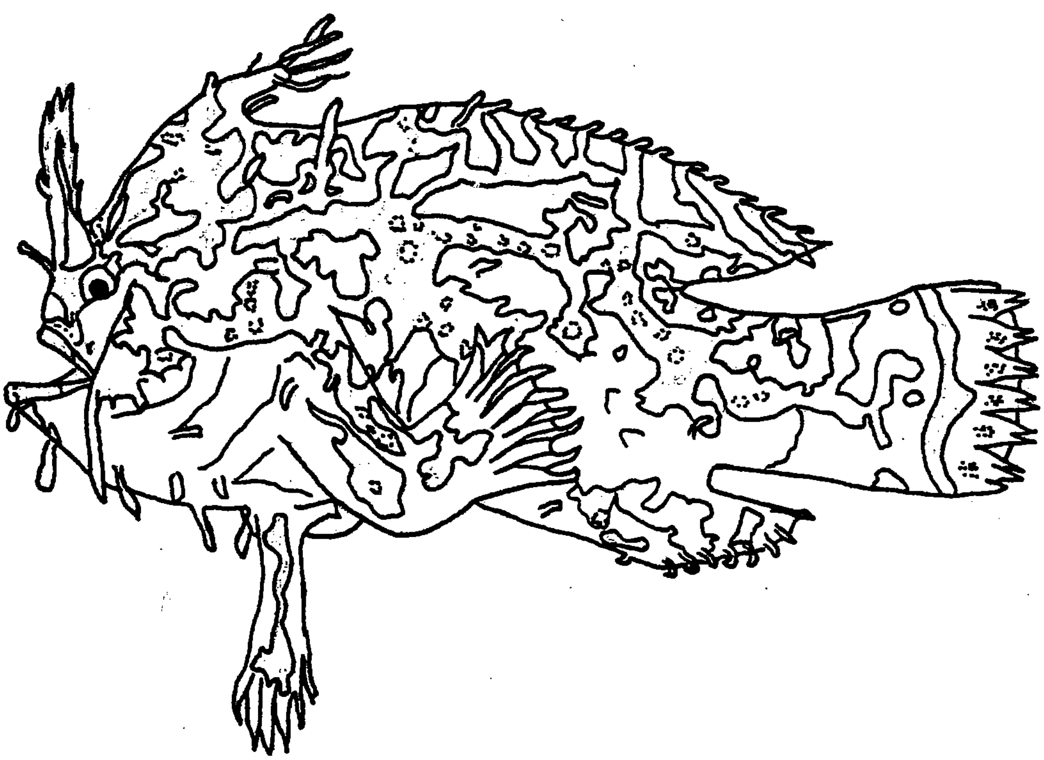


Contents

Summary

The educational program offered as the W-37 component of Introduction to Marine Science (NS 225 at Boston University) consisted of a formal classroom learning experience (31 lectures or seminars were presented), structured laboratory study, and participation in individual research projects. Viewed as an integrated whole, W-37 was divided into several different areas of concentration: there were short-term projects occupying the ship's company to the exclusion of most other concerns for up to a few days and longer ones involving continuous data collection and analysis for the entire 6 weeks of the voyage or major portions thereof. In the former category are placed:

1) <u>Whale Census on Navidad Bank</u>: This project required 4 days of intensive watching and listening during the day and zooplankton collection at night. Few whales were seen and Westward approached none. However, in that the results served to define a little more clearly the breeding season on Navidad Bank, the study can be considered satisfactory.

2) <u>Simultaneous Bongo and Meter Net Tows</u>: During one 24-hour period, while Westward was sailing between Jamaica and Cuba, the bongo nets and meter net were towed simultaneously at mid-depth and near the surface 4 times, 6 hours apart. The project was designed quantitatively to observe copepod vertical migration. The method of collection, a new one for Westward, was successful and will probably be used on future cruises.

3) <u>Reef Studies on Grand Cayman and Loggerhead Key</u>: Three weeks into the cruise Westward combined a reef study with an "R&R" stop in Grand Cayman. A total of 6 days were spent here, 3 of which were used in a thorough study of South Sound including lists of marine flora and fauna and student projects on sediments, fish diversity and reef development. This work combined with a similar study of Loggerhead Key in the Dry Tortugas off the tip of Florida provided an opportunity to compare the two reef environments biologically and for some students to use both reefs in order to explore the effect of physical elements on the growth and diversity of coral patch reefs, the competition of algae for reef surface space, damselfish territoriality and the feeding behavior of reef fishes.

4) <u>Longlining</u>: Westward set one longline during W-37 and caught 3 sharks, all female, and all of which were released alive and in good condition.

Summary, continued.

5) Ocean Thermal Energy Conversion: The OTEC project involved Westward's attempts to collect comprehensively as many different bits of environmental information as was possible in the area around a potential site for a thermal energy plant. The plant would be situated half-way between Key West and Cuba in the Straits of Florida. Westward's biological and chemical sampling enjoyed only moderate success due to bad weather and heavy seas.

Long-term projects during W-37 were designed both to explore as fully as possible the differences between major ocean basins that Westward traversed and to continue to work in the areas of ongoing concern to SEA's in-house research program. Projects which made use of the entire ship's track and 6 weeks or a major portion of it were the following:

1) Surface and Atmospheric Observations: Westward maintained a watch for pelagic and terrestrial birds, marine mammals, floating masses of driftwood and atmospheric phenomena.

An average of one pelagic bird a day was seen during the track into the Sargasso Sea while many more birds both pelagic and terrestrial were encountered or observed whenever Westward approached land.

A pod of large sperm whales appeared near Westward in the Windward Passage. The sightings during the remainder of the trip were confined primarily to far-away dolphins and the two grampuses which were seen in the Yucatan Straits.

Several times Westward pulled in floating debris and driftwood looking for shipworms (*Teredo* sp.). One instance yielded significant results: a trunk and root system honeycombed with *Teredo* burrows and many live molluscs. They will be given to Dr. Carl Berg at WHOI for examination.

Weather was reported daily throughout the trip and provided an opportunity for students to become familiar with the reality and credibility of weather forecasting.

2) Search for the Spawning Ground of the American Eel: Westward's track north from San Juan was originally designed to penetrate as far as possible into the hypothetical spawning ground of the American eel. Contrary winds prevented extensive penetration into the proposed area and few *Anguilla* larvae were found. They were hunted throughout the remainder of the trip but preliminary results have yielded only a single *Anguilla* leptocephalus.

Summary, continued.

However, a number of leptocephali from several other families were found leading to the question of spawning grounds for local populations of other kinds of eels.

3) Midwater Fauna and Vertical Migration: Extensive collecting in the mesopelagic region yielded an abundance of material to study. A project designed to delineate zoogeographical areas and boundaries was undertaken with some success using the Myctophidae. The existence of a hypothetical faunal boundary formed by Cuba, Hispaniola and the islands between the North Atlantic and Caribbean basins was given support by the results of this study.

The number, size and kinds of scarlet prawns collected in the Isaacs-Kidd Midwater Trawl were used to explore vertical migration and the relative importance of temperature and light in this phenomenon.

Solutions of varying pH were offered to bioluminescing organisms in an experiment to determine the optimal pH for luminescence. Results were inconclusive primarily due to the mortality problems involved in the sampling technique.

4) Sargassum and Neuston Studies: Floating *Sargassum* weed has proven in the past to be almost ubiquitous within the North Atlantic gyre and Caribbean. Unfortunately floating tarballs appear to be equally widespread. W-37 chose to explore relationships between floating tar and *Sargassum* communities and the amounts of tar collected and Westward's proximity to shipping lanes. As was expected, the tar content of the surface water was greatest around shipping lanes, but surprisingly, the greatest degree of growth and encrustation of Sargassum weed seemed to occur when the mass of weed was severely clogged with tarballs.

One of Westward's most popular group projects has been the establishment and maintenance of salt water aquaria during a cruise. On W-37, Westward was fortunate enough to capture a pair of large (7 cm) *Sargassum* fish, *Histrio histrio*, which survived for over a month, mated, and eventually produced eggs every 3 days. Although none of the eggs were fertilized, the presence of healthy specimens provided an unparalleled opportunity to study the behavior and biology of some rather unique fish.

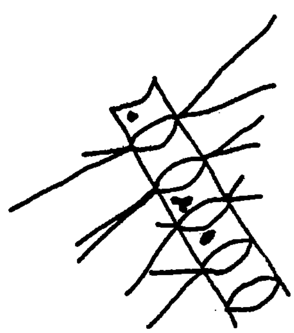
5) Water Chemistry and Phytoplankton Systematics and Diversity: Numerous hydrographic stations were occupied during W-37, designed both

Summary, continued.

to provide students with an insight into marine chemistry methodology and to supplement the biological collecting with a description of the chemical environment. Westward sampled the entire water column in three different basins for salinity, dissolved oxygen, and reactive phosphorus. Distinctly different chemical environments were shown in the three basins.

The phytoplankton studies were linked to hydrography in an effort to demonstrate the relationship between nutrients, gases, dissolved solids and the lowest organisms on the food chain, the primary producers.

The psychobiological study done by one student fits into neither category of long-term endeavors but the sociological/psychological problem of 34 people confined in 100 ft. for 6 weeks has long been considered a fascinating one. The situation was considered in the light of expectation and reality on W-37. Results suggested that males have more realistic expectations of the physical stresses that they actually undergo on the ship and females have more realistic expectations of the emotional ones.



A.D.

Chaetoceros decipiens

Introduction

This report presents the results in abstract form of 6 weeks of intensive effort on the part of the students and staff of W-37. The primary purpose of the cruise was to give students widespread exposure to the techniques of oceanographic data collection and reduction, to present the marine environment to them as an interrelated whole and to give students the opportunity to pursue individual interests and demonstrate scientific scholarship in their treatment of these interests. This objective was accomplished equally through a variety of lectures, watch operations, and individual project work.

Research conducted during W-37 partly represents ongoing work of individuals and agencies that have extended their assistance to our students. Material reported here should not be excerpted or cited without written permission of the Chief Scientist.

Table 1. Itinerary W-37.

Port	Arrival	Departure
San Juan	--	Nov. 30
Grand Cayman	Dec. 21	Dec. 26
Key West	Jan. 3	Jan. 4
Dry Tortugas	Jan. 5	Jan. 8
Key West	Jan. 11	--

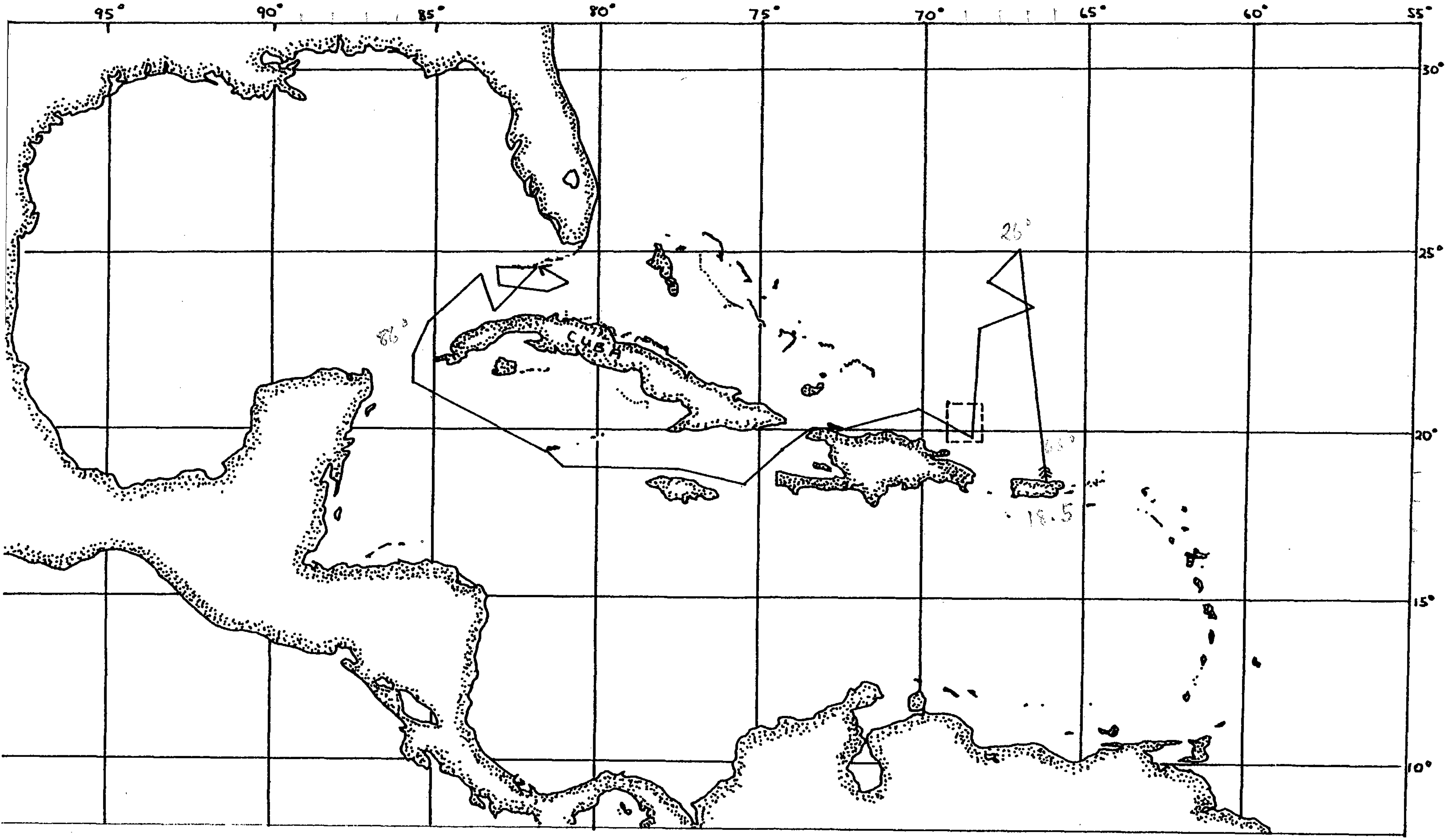


Fig. 1. A. Cruise track for W-37. Dashed box shows area enlarged in part B (next page).

Fig. 1B. Four-day transect of whale bank.

X = Listening station
W = Whale sighting

--- = daylight transect (0700-1900)
___ = nighttime transect (1900-0700)

12/10 = ●
12/11 = ▲
12/12 = ○
12/13 = △
12/14 = ◉

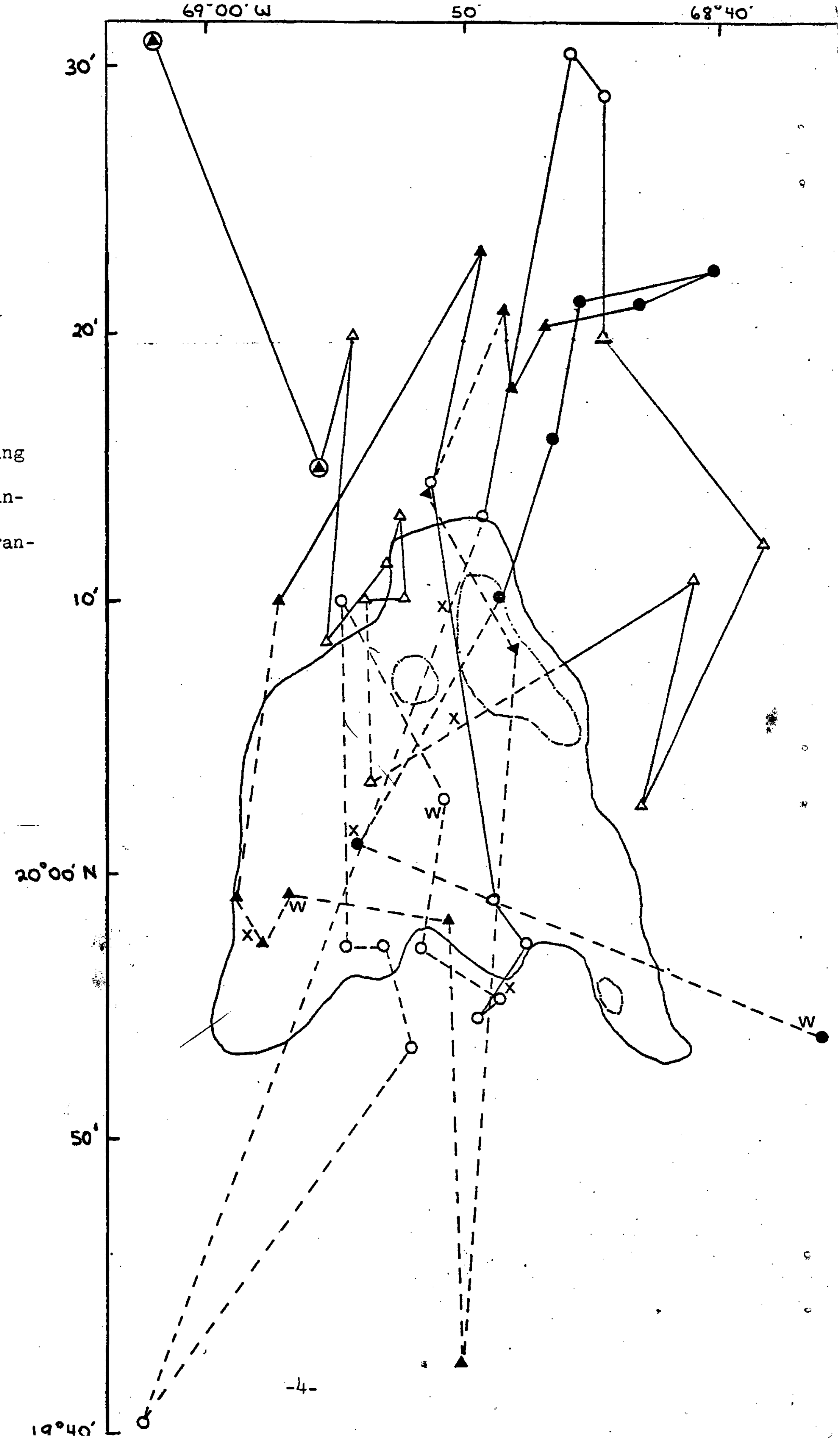


Table 2. W-37 Ship's complement.

Nautical Staff	
Jonathan Lucas, M.M.	Captain
Carl Chase, B.A.	Chief Mate
Ken Hamilton	2nd Mate
Jack Morton, M.A.	3rd Mate
Gary Manter, A.M.S.	Chief Engineer
Sally Kaul, B.S.	Steward
Scientific Staff	
Molly D. Allison, M.S.	Chief Scientist
Carl M. Baum, B.S.	Scientist-2
George Goldsmith, Ph.D.	Scientist-3
Students	**College**
Steve Afflixio	U. of Rhode Island, R.I.
Jack Boltax	S.U.N.Y., Binghamton, N.Y.
Kevin Boyle	St. Olaf College, Minn.
Steve Burnham	Dartmouth College, N.H. (Sf*)
Wendy Cohn	Colby College, Me.
Barbara Cook	Oberlin College, Ohio
Amy Davidoff	Colby College, Me.
Keith Eddings	George Washington U., D.C.
Joan Gamble	Wesleyan College, Conn.
Helen Gordan	Wellesley College, Mass.
Mary (Tatsy) Guild	Bennington College, Vt.
Frank Helsell	U. of Colorado, Colo.
Andrew Korn	American U., D.C.
Carol Knowles	Keene State College, N.H.
Deborah Lieberman	Colby College, Me.
Todd Pizer	American U., D.C.

(continued)

Ship's complement (continued)

Students	College
Leah Postman	Oberlin College, Ohio
Andrew (Puff) Puffer	Black Hawk College, Ill.
Philip Rogers	C.W. Post College, N.Y.
Philip Round	St. Lawrence U., N.Y.
Craig Russell	Washington State U., Wash.
Dave Sloatman	Cornell U., N.Y.
Sylvia Wolf	Northwestern U., Ill.

Academic Program

Lectures

During the first half of the trip lectures were presented daily by a member of the science staff and were designed to correlate closely with and relate directly to the station work being done in the laboratory. Lecture time during the latter part of the cruise was taken up by students presenting and discussing their individual project results (Table 3).

Science Watch

The bulk of the scientific education on Westward occurred during the science watch periods. Three students were on science watch at any one time and were given the opportunity for individual instruction in the techniques of biological, chemical and physical data collection and reduction as well as a chance to work on and discuss their own projects. (See Table 4 for the major sampling operations during W-37.) Often formal questions were asked during a laboratory watch which required continuous concerted effort on the part of the students during several of their science watch periods. Quizzes were given after major units of information had been presented. In addition, a written record of observations made by the students during the reef studies was required. A practical examination based on organisms collected during watch (Table 5) formed a significant portion of the final examination.

Shore Visits

While in port students had an opportunity to visit the following points of interest:

The Turtle Farm Grand Cayman	(the only green turtle aquaculture facility in the world)
Fort Jefferson National Monument Garden Key, Dry Tortugas	(the largest masonery fort in North America where three of the Lincoln Conspirators were imprisoned)

Table 3. Lectures and seminars presented during W-37.

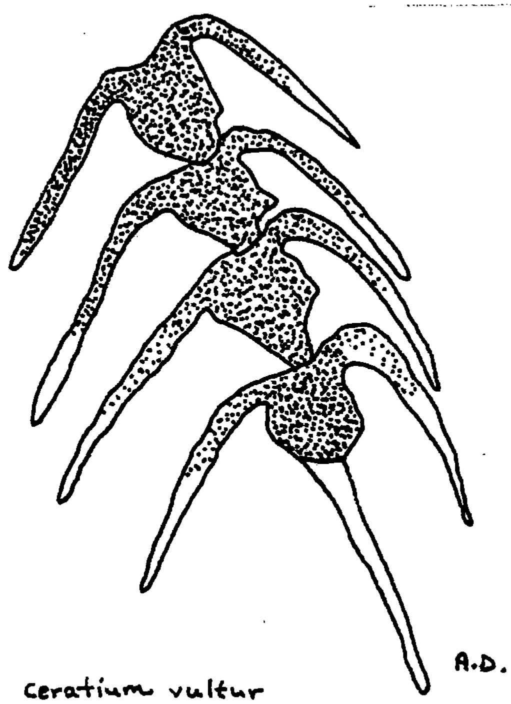
Date	Subject	Instructor
Dec. 1	The bathythermograph	Allison
2	Determination of salinity	Allison
5	Reversing thermometers	Allison
6	Sargassum communities	Allison
7	Introduction to fish biology	Baum
8	Whale identification. I. Large whales	Allison
9	Whale biology + diving physiology	Allison/ Baum
12	Biological sampling	Allison
13	Ocean thermal energy conversion	Goldsmith
15	Whale identification. II. Dolphins	Allison
16	Mesopelagic ecology. I.	Baum
19	Coral reef formation and ecology	*Boltax/ *Lieberman
20	Cayman Island natural history	Allison
27	Reef feeding habits	Allison
28	Mesopelagic ecology. II.	Baum
29	Copepods	Allison
30	The longline	Baum
Jan. 5	Distribution of <u>Leptocephalus</u> larvae with particular emphasis on <u>Anguilla rostrato</u>	*Afflixio
6	Zoogeography of midwater fish of the family <u>Myctophidae</u>	*Korn
	Whales and krill on Navidad Bank	*Eddings
	Reactive phosphorus in the Sargasso Sea and the Caribbean	*Helsell
	Dissolved oxygen profiles in the Sargasso Sea and the Caribbean	*Puffer
	Phytoplankton diversity with particular regard to distribution and abundance of <u>Trichodesmium</u>	*Davidoff

(continued)

Lectures and seminars presented during W-37 (continued)

Jan. 8	Cetacean play behavior	*Guild
	Realities vs. expectations in life at sea	*Cohn
	Copepods as part of the deep scattering layer	*Russell
9	Sediment distribution, South Sound, Grand Cayman	*Gamble
	pH and bioluminescence	*Cook
	Damselfish behavior on the reef	*Knowles
	Distribution of tar balls in relation to proximity of shipping lanes	*Round
	Tar balls and their effect on Sargassum encrustations	*Sloatman

*Student presentation.



Ceratium vultur

Table 4. W-37 Sampling operations

Operation	Number
Bathythermographs	36
Phytoplankton tows	5
Neuston tows	13
Hydrocasts	16
Chemical determinations	
Dissolved oxygen	61
Salinity	71
Phosphate	80
Longline sets	1
Weather observations and transmissions	27
Reef dives	10
Isaacs-Kidd midwater trawls	7
Zooplankton bongo tows	11
Otter trawls	1
Listening stations	6
Whale watch	55 hours
Shipworm sampling	3
Simultaneous bongo and meter net tows	4

Table 5. W-37 Demonstration organisms
(Feature Creatures)

Organism	Common Name
Phylum Cyanophyta	
Trichodesmium erythraem	Blue-green algae
Phylum Phaeophyta	
Sargassum natans	Sargassum weed
Phylum Cnidaria	
Porpita linneana	Blue button
Physalia physalia	Portugese Man-o-Wa
Bunodosoma cavernata	Warty sea anemone
Phylum Echinodermata	
Diadema antillarum	Long-spined sea ur
Ophioderma brevispinam	Brittle star
Phylum Chaetognatha	
Krohnitta sp.	Arrow worm
Phylum Annelida	
Callizona sp.	Bristle worm
Phylum Mollusca	
Loligo vulgaris	Squid
Pterotrachea coronata	Pteropod
Acanthopleura sp.	Chiton
Phylum Arthropoda	
Systellaspis debilis	Scarlet prawn
Halobates micans	Water strider
Palinurus vulgaris	Phyllosoma larvae spiny lobster
Portunus sayi	Sargassum crab
Calanus sp.	Copepod
Phylum Chordata	
Pyrosoma atlanticum	Colonial tunicate
Cypselurus sp.	Flying fish
Coryphaena hippurus	Dolphin fish
Pelicanus occidentalis	Brown pelican
Salpa maxima	Salp
Chauliodus sloani	Viper fish
Physeter cetadon	Sperm whale
Histrio histrio	Sargassum fish
Argyropelecus aculeata	Hatchet fish
Carcharhinus obscurus	Dusky shark
Chelonia mydas	Green sea turtle

Research Activities

Cooperative Programs

Cooperative Ship Weather Observation Program (NOAA)

Westward is part of a network of ships which compile and transmit synoptic weather reports for the U. S. National Oceanic and Atmospheric Association. During W-37 weather conditions were observed and recorded 27 times, generally at 0000 and 0600 GMT. 63% were successfully transmitted by radio to New Orleans, Portsmouth, Virginia or Boston. (See Table 6) These observations combined with a weather log submitted as a student project comprise a detailed meteorological record for W-37.

Shark Tagging (NMFS)

In cooperation with Jack Casey at the Narragansett Lab, National Marine Fisheries Service, Westward attempts to tag, identify and characterize sharks. The NMFS project endeavors to discover and explain the apparent migratory habits of certain species of sharks in the North Atlantic.

One longline was set during W-37 offshore from Key West using 12-week old half mackerel preserved in brine as bait. The set was chummed liberally with the bait brine and 3 healthy sharks -- two Dusky (Carcharinus obscurus) and one Tiger (Galeocerdo cuvieri) -- of moderate size were caught, tagged and released. (See Table 7)

Collection of Shipworms from Floating Driftwood

In cooperation with Dr. Carl J. Berg (Marine Biological Lab, Woods Hole) Westward collected and preserved samples of wood found floating in the open sea. These samples will be examined for shipworms (*Teredo* sp.), and the age and origin of the wood determined. (See Table 8)

Table 6. W-37 Ship's weather observations

$99L_aL_aL_a$	$Q_cL_oL_oL_o$	$YYGGi_w$	Nddff	VVwwW	PPPTT	$N_hC_LhC_MC_H$	D_sv_sapp	$OT_sT_sT_dT_d$	$1T_wT_wT_w{}^tT$	$3P_wP_wH_wH_w$	$d_wd_wP_wH_wH_w$
99230	70665	04063	21410	99031	15427	18350	81717	00223	12628	3//01	11603
99242	70667	05003	11605	99021	17225	14200	81211	05024	12619	30000	10501
99243	70678	06063	31612	98181	14326	34200	52605	05325	12751	30101	16501
99238	70673	07003	21815	98020	12927	/1/00	31400	00226	12632	30101	13702
99237	70667	07063	12010	99010	13526	15200	32707	00221	12621	3//01	18702
99230	70673	08003	12006	99021	14126	11300	51211	05024	12687	3//01	20501
99229	70679	08063	12005	99020	15226	11/00	61202	05025	12697	30201	25402
99200	70683	10063	11312	98021	15226	124//	00718	00420	12728	3//01	09502
99203	70688	11003	01212	99020	14826	00900	11206	05124	12717	30301	12502
99204	70687	11063	51305	99021	15528	51///	00211	0//24	12723	30301	27562
99203	70688	12003	20903	99031	14727	253//	11400	0//23	12712	3//01	11501
99203	70689	12063	10903	99020	15027	14400	17506	00024	12700	3//01	11501
99204	70689	13003	50915	99031	15727	34341	11209	00825	12708	3//03	04504
99202	70687	13063	40920	98038	14726	4831/	41607	00324	12707	3//03	09604
99202	70688	14003	41112	98011	15827	48311	41207	00225	12708	30301	13502
99203	70690	14063	20915	98011	16127	28///	71707	00224	12702	3////	14603
99203	70713	15063	11012	98250	11425	17200	41714	05324	12726	30301	10702
99200	70730	16003	10905	99011	12327	00901	62302	05223	12802	30201	09501
99199	70736	16063	10902	99020	11827	0//01	51718	05023	12802	3//01	14502
99188	70770	18063	71607	99031	10127	00428	72809	05623	12782	3//01	11702
99215	70856	29063	00712	99000	18922	00001	72206	05716	12652	3//02	05703
99223	70853	30063	30912	98020	17123	32400	11804	0//18	12609	3//02	07502
99229	70849	30123	41206	99010	16522	41305	11504	05819	12612	30201	09502
99241	70839	31063	10706	99020	16623	14200	81808	05122	12353	30201	09702
99245	70835	31123	00902	99000	15223	00/00	114//	00023	12300	3//00	09501
99240	70821	02063	70000	98022	14525	2525/	71303	00424	12386	30000	99500
99245	70826	05063	23615	98020	21921	00431	61703	00219	12234	30301	02501

Key: $L_aL_aL_a$ = latitude in degrees and tenths; Q_c = quadrant of globe; $L_oL_oL_o$ = longitude in degrees and tenths; YY = day of month; GG = Greenwich mean time; i_w = wind indicator; N = total cloud amount; dd = wind direction; ff = wind speed; VV = visibility; ww = present weather; W = past weather; PPP = sea level pressure; TT = air 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.

Weather Recording and Forecasting on W-37

Steve Burnham

Abstract

A weather log was kept during cruise W-37 as a learning tool and to compile data for forecasting. The log was kept every hour during the cruise for barometric pressure, wind speed, wind direction, cloud type, percent cloud cover, relative humidity, wave height and air temperature. There was also a remarks column and a rough track of the ship's position. The Marinefax weather machine was also used to produce 10 maps during the cruise. Forecasts were mostly done in the Straits of Florida and were accurate approximately 75 percent of the time.

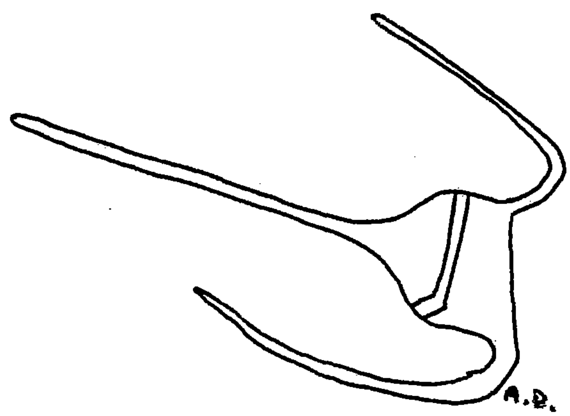
Table 7. W-37 Longlining results.

Position: off Key West, Straits of Florida (24°21'N, 83°45'W)
Date: January 2, 1978
Time out: 0803
Time in: 1756
Time overboard: 9.9 hours
Number of hooks: 71
Depth of set: 4-20 m
Bait: salted half mackerel; squid

Catch	Size (m)	Sex	Remarks
Carcharhinus obscurus (Dusky)	2.2	F	Released alive, healthy.
C. obscurus	1.7	F	Released alive, healthy.
Galeocerdo cuvieri (Tiger)	2.2	F	Released alive, healthy.

Table 8. Shipworm Collection Log

Date	Time	Location	Samples	Remarks
10 Dec	0935	19°56.5'N 68°43'W	Bamboo	No shipworms
16 Dec	0800	19°48'N 73°47.9'W	Pine	No shipworms 3X6 beam
31 Dec	1300	24°20'N 83°31'W	Trunk and root system	Shipworms present



Ceratium trichoceros

Ocean Thermal Energy Conversion (ERDA)

Extremely comprehensive environmental monitoring is necessary whenever contemplating placement of power plants at sea, not only for environmental impact statements but for use in the planning and design of the plants themselves. A prospective site for a thermal energy conversion plant exists approximately half-way between Key West and Cuba in the center of the Florida Straits. *Westward* collected data for use in assessing the value of the site in cooperation with Robert Cohen, Ocean Systems Branch, Energy Research and Development Association. Details of temperature, salinity and oxygen distribution in the water column will be forwarded to ERDA.

1. Observations of numbers and behavior of marine mammals in their winter mating/calving grounds on Navidad Bank and the relationship of marine mammals to their environment.

Cetacean Behavior

Leah R. Postman

Abstract

This study was designed to observe and categorize marine mammal behavior, ultimately comparing and contrasting noted patterns with the known behavioral patterns of their terrestrial counterparts. However, the severely limited number of high quality cetacean sightings (7), made it impossible to define any behavioral patterns. Similarities were noted between the circling technique of investigative behavior of humpback and sperm whales and the more timid grampus, with that of wild canines and felines. Similarities were also noted between the play behavior of the observed bottlenose dolphins and domesticated canines: they both seem capable of instigating and repeating a patterned game. (See Table 9 and Figures 1B. and 2 for the log summary and position of marine mammals seen during W-37.)

Cetacean Play Behavior

Tatsy Guild

Abstract

Cetacean play behavior was observed in light of its possible correlation with higher intelligence. In the past cetaceans have been observed in what appeared to be highly organized communal play, behavior previously observed only in man. Unfortunately, available data on W-37 did not lead to conclusive results.

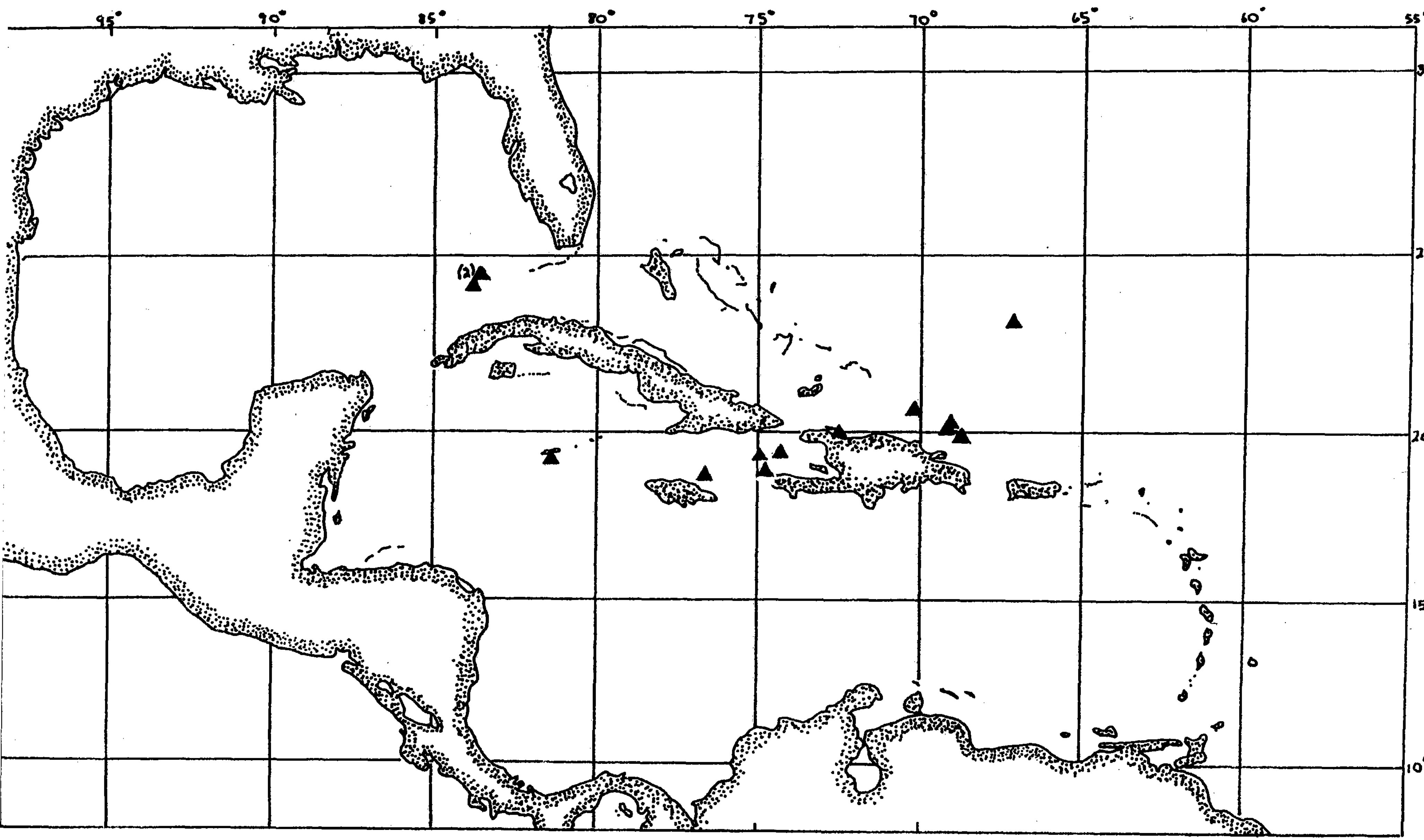


Fig. 2. Positions of marine mammal sightings on cruise W-37.

Table 9. Marine mammal sightings during cruise W-37

	Marine mammal	ID	No.	Size (ft)	Date	Time	North Latitude	West Longitude	Mode	Speed (kt)	Direction	Position
1.	Unidentified whale	-	1	-	12/7	1520	23°11'	66°57'	Sail	-	NE - SW	Stbd. quart.
2.	Unidentified whale	-	2	-	12/10	0723	19°53'	68°37'	Sail	-	W - E	Bow
3.	*Megaptera noviangliae*	1	1	25-35	12/11	1450	19°59'	68°51'	Sail	2	NE - SW	Bow
4.	Unidentified whale	-	1	-	12/12	0747	20°03'	68°57'	Sail	-	N - S	Abeam
5.	Unidentified whale	-	1	-	12/14	1255	20°41'	70°05'	Sail	1-2	W - E	Astern
6	Unidentified dolphin	-	6-8	6-8	12/15	1610	19°59'	72°32'	Sail	4-5	NW - SE	Bow
7.	*Physeter catodon*	+	5	35	12/16	1430	19°23'	74°15'	Power	1-2	W - E	Bow + abeam
8	Unidentified dolphin	-	10-12	4-6	12/16	1915	19°04'	74°39'	Sail	3	-	Bow
9	Unidentified dolphin	-	5-7	4	12/17	0220	18°52'	74°43'	Sail	6	-	Bow
10.	Unidentified dolphin	-	10	4	12/17	2130	18°32'	76°33'	Power	9	-	Bow
11.	Unidentified dolphin	-	4-6	4-5	12/20	2330	19°04'	81°12'	H/T	3	-	Bow
12.	*Tursiops truncatus*	1	8-9	6-7	12/31	0840	24°28'	83°32'	Sail	-	N - S	Abeam
13.	*Grampus griseus*	2	7	12	12/31	0935	24°29'	83°32'	Sail	1-2	NE - SW	Port quart.
14	Unidentified dolphin	-	2-3	-	1/1	2305	24°07'	83°39'	Sail	-	-	Bow

Key: Quality of ID:

1 = Excellent, no chance of mistake.

2 = Good, high probability of correct ID.

3 = Fair, distance or conditions somewhat marginal.

Krill Density on Navidad Banks

Keith Eddings

Abstract

Theoretically, humpback whales (Megaptera novaeangliae) do not feed while at the mating and calving grounds on the Navidad and Silver Banks. Using bongo nets towed at 500m depth the density of krill populations just northeast of Navidad banks was estimated. The density of euphausids from December 10-12 was 0.01 to 0.02 euphausids per m^3. Although this value is probably an underestimate due to the shallow depth of the sampling, the estimated whale population could probably not be supported on such a low density of krill. Therefore, the whales are probably not feeding on krill while on the banks.

2. Distribution and migration of leptocephalus larvae of the American eel, Anguilla rostrata.

Distribution and abundance of leptocephalus larvae with particular emphasis on those of the American eel, Anguilla rostrata

Steve Afflixio

Abstract

It has been suggested that Anguilla rostrata, the American eel, spawns somewhere within the boundaries of the Sargasso Sea. Theoretically, the larger the larvae, the farther it is from its place of hatching. By plotting the position and size of each larvae, a hypothetical spawning ground can be located. Tows were made with Bongo nets and an Isaacs-Kidd Midwater Trawl at depths ranging from 50 to 500 meters. 83 leptocephalus larvae were collected from the Sargasso and Caribbean Seas and the Straits of Florida, primarily of the families Muraenidae, Congridae and Opichthidae. Further study needs to be done to clarify the origin and migratory routes of these larvae but no conclusions can be drawn regarding the Anguilla spawning problem since only one American eel larvae was caught. (Table 10 and Figure 3)

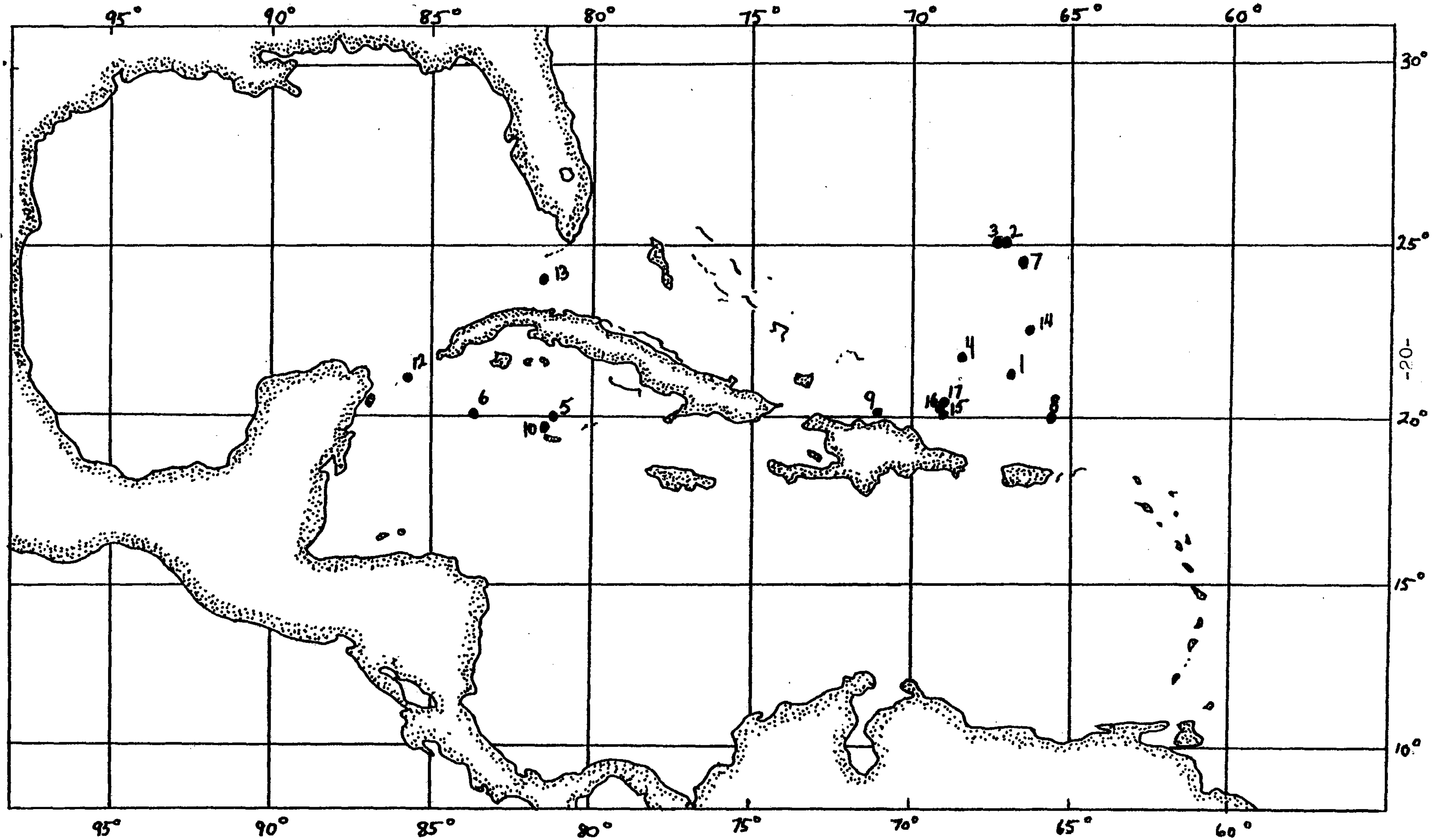


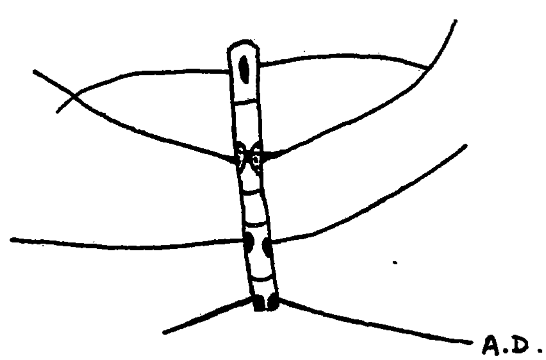
Fig. 3. Eel larvae stations on cruise W-37. Numbers correspond to stations listed in Table 10.

Table 10. Eel larvae abundance. ES = eel station; IK = Isaacs-Kidd midwater trawl station; BT = bongo net tow station.

Station	Position N	Position W	Type of Station	Depth of Tow (m)	Total Eels	Muraenidae	Congridae	Anguillidae	Opichthidae	Others*
1	20°58'	66°41'	ES 1	50 & 25	0	0	0	0	0	0
2	25°03'	67°03'	ES 2	50 & 25	3	0	0	0	0	3
3	25°00'	67°10'	ES 3	50 & 25	1	0	0	0	0	1
4	22°04'	68°08'	ES 4	50 & 25	16	1	12	0	1	2
5	19°53'	80°55'	ES 5	50 & 25	0	0	0	0	0	0
6	20°16'	83°26'	ES 6	50 & 25	12	2	5	0	2	3
7	24°33'	67°30'	IK 1	85	2	1	0	1	0	0
8	20°00'	65°22'	IK 2	--	9	0	6	0	2	1
9	20°27'	70°50'	IK 3	100 & 50	10	4	3	0	0	3
10	19°04'	81°12'	IK 4	200 & 100	1	0	0	0	0	1
11	--		IK 5	---	1	0	0	0	0	1
12	21°05'	85°24'	IK 6	500 & 200	0	0	0	0	0	0
13	24°00'	82°09'	IK 7	500 & 200	5	0	5	0	0	0
14	22°30'	66°26'	BT 1	50 & 25	1	1	0	0	0	0
15	20°15'	68°48'	BT 2	50	3	3	0	0	0	0
16	20°23'	68°49'	BT 3	300 & 200	0	0	0	0	0	0
17	20°32'	68°48'	BT 4	500	0	0	0	0	0	0

*Others = Xenocongridae (4); Nettastomidae (2); Synophobranchidae (1); and Nemichthydae (4). Also included were 3 larvae from the order Notacanthiformes.

NB. Sampling at eel stations was done by bongo tows.



Bacteriostrum delicatulum

3. Avifauna Observations

Bird Studies

Helen Gordon

Abstract

A log of bird sightings during W-37 was kept with the primary purpose of noting some correlation between different species and where they were sighted. (Table 11) Questions were posed concerning the effects of distance from shore, weather, and in some cases size or feeding habits. At Grand Cayman the weather was not good for bird watching because of a 'norther' which hit shore soon after Westward did. Results showed that evidently off the shore of Cuba and Haiti in the Windward Passage and generally near shorelines the average number of sightings increased.

4. Systematics, distribution and ecology of midwater fauna.

Zoogeography of the midwater fish family Myctophidae

Andy Korn

Abstract

The presence of a zoogeographical (faunal) boundary between the Sargasso Sea and the Caribbean Sea was investigated using individuals of the fish family Myctophidae as the indicator organisms due to their abundance and ocean-wide circulation. Sampling at various depths was done with an Isaacs-Kidd Midwater Trawl and a bongo net. The data was then compared to that previously reported by other investigators. The presence of such a boundary was demonstrated by this study within the sampling limitations of the program and the data did correlate with that presented in the literature.

(Tables 12, 13, 14 and Figure 4)

Table 11. Bird log. W-37.

Species	Sargasso	Grand Cayman	Straits of Fla. & Key West	Dry Tortugas/ Loggerhead Key	Other Ocean*	Common Name
Frigata magnificens	+	+	+		+	Frigate bird
Rissa tridactyla	+				+	Kittiwake
Larus atrieilla			+			Laughing gull
L. argentatus				+	+	Herring gull
L. marinus		+	+			Blackbacked gull
L. delawarensis					+	Ringbilled gull
Sterna hirundo		+	+	+	+	Common tern
Thallasseus maximus		+				Royal tern
Sterna fuseate			+			Sooty tern
Sula dactylatra					+	Bluefaced booby
Moris bassana					+	Gannet
Stercorarius parasiticus					+	Parasitic jaeger
Stercorarius pomarinus					+	Pomarine jaeger
Phalacrocorax auritus				+		Double-crested cormorant
*Pelicanus occidentalis***			+	+		Brown Pelican
Ardia herodias				+		Great blue heron
Florida coerulea		+	+			Little blue heron
Hirundo rustica erythrogaster					+	Barn swallow
Petrochelidon pyrrhonota					+	Cliff swallow
Coereba bahamensis		+				Bananaquit
Vireo flavifrons		+				Yellow-throated vireo
Buteo brachyurus			+			Short-tailed hawk
Mimus polyglottus		+				Mockingbird

*The term "other ocean" encompasses Navidad Banks and any open water near shore such as the Windward Passage, off Cuba, and off Haiti.

**Also sighted in San Juan Harbor.

Table 12. Myctophid fish collected on W-37. BT = bongo tow; IK = Isaacs-Kidd midwater trawl.

Genus	Site A BT1	Site B IK1	Site C IK2	Site D IK3	Site E IK4	Site F IK5	Site G IK6	Site H IK7	Total No. per Genus	% of each Genus
Bolinichthys	0	1	0	0	0	0	0	0	1	1.1
Ceratoscopelus	10	8	0	5	1	7	0	12	43	48.3
Diaphus	2	1	2	13	0	1	0	0	19	21.3
Hygophym	0	0	0	0	3	3	0	1	7	7.9
Lampanyctus	1	0	0	0	0	0	0	0	1	1.1
Notolychnus	0	2	0	1	0	1	0	5	9	10.1
Protomyctophum	1	0	0	0	0	0	0	1	2	2.2
Unidentified	0	0	2	3	0	1	0	1	7	7.9
Total per site	14	12	4	22	4	13	0	20	89	

Table 13. Percentage and ranking of representative Myctophid genera in each region. W = W-37 data; L = data from the literature.

Genus	Subtropical Percent W	Subtropical Percent L	Subtropical Ranking W	Subtropical Ranking L	Tropical Percent W	Tropical Percent L	Tropical Ranking W	Tropical Ranking L	Mexican Gulf Percent W	Mexican Gulf Percent L	Mexican Gulf Ranking W	Mexican Gulf Ranking L
Bolinichthys	1.9	7.6	4	4	0	2.2	5	6	0	0.9	5	6
Ceratoscopelus	44.2	12.7	1	3	47.1	12.5	1	2	60.0	6.5	1	4
Diaphus	34.6	7.4	2	5	5.9	31.6	3	1	0	29.0	5	1
Hygophum	0	2.8	7	6	35.3	2.8	2	5	5.0	7.8	3	3
Lampanyctus	1.9	15.5	4	2	0	8.1	5	4	0	16.8	5	2
Notolychnus	5.8	18.5	3	1	5.9	11.9	3	3	25.0	5.0	2	5
Protomyctophum	1.9	0	4	7	0	0	5	7	5.0	0	3	7

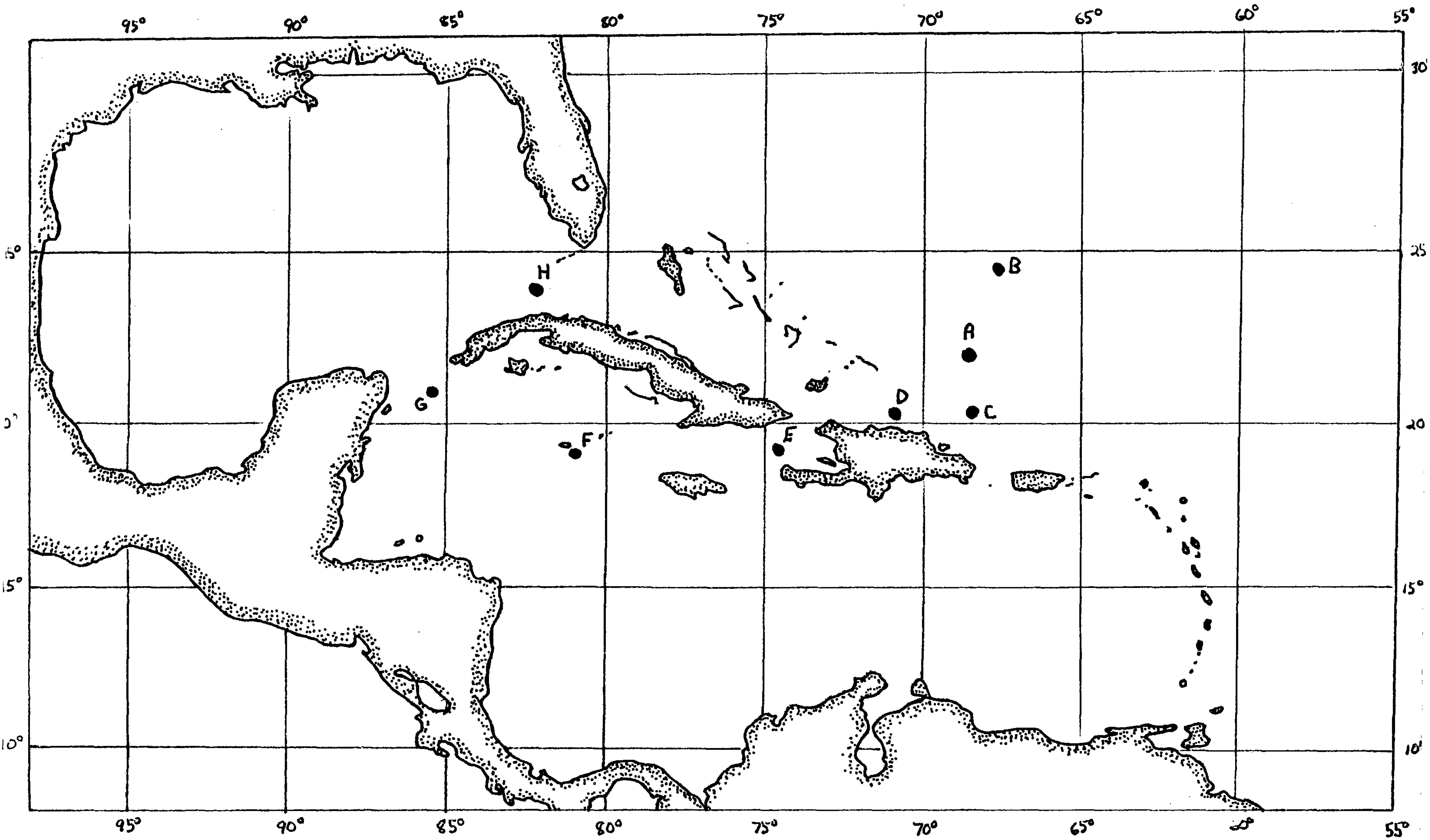


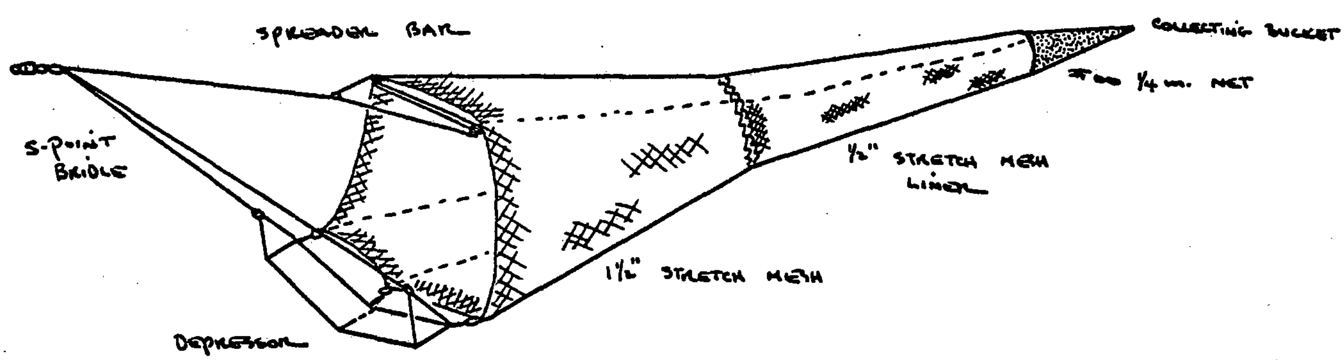
Fig. 4. Myctophid sampling sites on cruise W-37. Letters correspond to sites listed in Table 13.

Table 14. W-37 Isaacs-Kidd midwater trawl log.

Station	Date	LMT	North Latitude	West Longitude	Depth (m)	T_s (°C)	T_z (°C)
1	12/5	2040	24°33'	67°30'	85	27.5	23.6
2	12/9	2040	20°11'	65°22'	75	27.0	26.7
3	12/14	2100	20°27'	70°50'	50/100	27.1	27.2
4	12/16	2100	19°00'	74°44'	100/200	27.9	22.8
5	12/21	0000	19°04'	81°12'	200/500	27.7	26.5
6	12/28	2200	21°05'	85°24'	200/500	26.5	16.8
7	1/1	2100	24°00'	82°09'	200/500	23.6	10.6

Key: LMT = average local mean time at sampling period.
T_s = surface temperature.
T_z = approximate average temperature at depth (z).

6' ISAACS-KIDD MIDWATER TRAWL

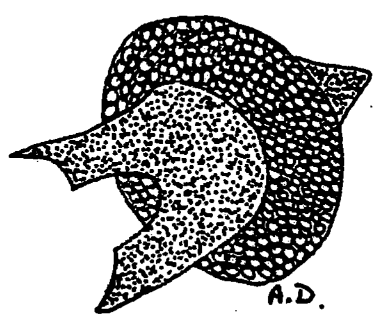


Scarlet Prawns and the Deep Scattering Layer

Kevin Boyle

Abstract

Moore (1950) has demonstrated that the deep scattering layer rises and falls according to an optimal light level but its greatest depth is determined by temperature. This study suggested that temperature may have an effect on how high the deep scattering layer rises, using scarlet prawns as indicator organisms. Without regard to the local productivity of the water, the data collected on W-37 support the hypothesis--the animals collected did not rise as high in warmer water as they did in colder water. (Table 15)



Peridinium sp.

Table 15 . Scarlet prawns collected in the Isaacs-Kidd midwater trawl on W-37.

Station	Species	No. in tow	Size (cm)	Average Size (cm)	Diversity Index*
1	Pandalus borealis	1	4.0		
	P. borealis	2	2.5		
	Sergestes robustus+	2	2.5		
	Systellaspis debilis**	1	4.0		
	Sergestes vigilax	2	3.5	3.1	1.44
2	P. borealis	6	4.0		
	P. borealis	1	3.0		
	P. borealis	1	2.0	3.6	0
3	P. borealis++	27	4.0		
	P. borealis	2	2.5		
	S. vigilax**	2	2.5	3.8	0.56
4	P. borealis	1	5.5		
	P. borealis	2	4.0		
	Sergestes robustus	1	5.0		
	Systellaspis debilis	3	6.0		
	Acanthephyra purpurea	1	5.5		
	Sergestes arcticus	2	5.0		
	S. arcticus	1	4.0		
	S. arcticus	1	3.0	4.8	0.91
5	S. robustus	1	8.0		
	S. robustus	2	6.0		
	S. robustus	1	4.0		
	S. robustus**	3	3.0		
	S. vigilax	1	4.0		
	S. vigilax	2	3.0		
	S. vigilax**	1	2.0	4.0	0.62
6	P. borealis	2	8.0		
	S. robustus	1	8.0		
	S. robustus	1	5.0		
	S. robustus**	2	3.0		
	S. vigilax	2	4.0		
	S. vigilax	2	3.0		
	S. vigilax**	1	2.0		
	S. arcticus	1	4.0		
	Sergestes sp.	3	3.0	4.3	1.48

(continued)

Scarlet prawns collected in the Isaacs-Kidd midwater trawl on W-37 (continued)

7	*Sergestes robustus*	1	6.0		
	S. robustus	1	5.0		
	*S. robustus***	1	3.0		
	S. vigilax	1	4.0		
	*S. vigilax***	4	2.0		
	S. arcticus	2	4.0		
	S. arcticus	1	3.0		
	*S. arcticus***	1	2.0		
	Sergestes sp.	2	4.0		
	Sergestes sp.	1	2.0		
	Systellaspis debilis	3	5.0		
	Dichelopandalus sp.	1	5.0		
	*Dichelopandalus sp.***	2	3.0		
				3.6	1.64

*Diversity Index = $(S-1)/\ln N$ where S = number of scarlet prawn species in the sample and N = the total number of scarlet prawns in the sample.

+Intermediate stage

**Juvenile stage

++Many with brooded eggs

NB: Stations 6 and 7 contained also the large scarlet mysid, *Gnathophausia sp.*, size 10 cm. in tow 6 and 4 cm. in tow 7.

pH and Bioluminescence

Barb Cook

Abstract

With solutions of varying pH, ranging from 4 to 12, different luminescing organisms were tested to try to determine optimal pH for bioluminescence. Results from organisms with internal light organs were inconclusive. Bacteria and organisms with photophores near the surface bioluminesced optimally at neutral or slightly basic pH.

Vertical Migration of Zooplankton

Craig Russell

Abstract

Many species of zooplankton exhibit diurnal vertical migration in response to light intensity. Simultaneous tows at 10m (meter net) and 150m (bongo nets) were made at dawn, mid-day, dusk, and midnight in the Caribbean Sea.

At both 10m and 150m biomass concentration was higher at dawn and dusk than at mid-day and midnight. The number of copepods at 10m was also higher at dawn and dusk than at mid-day and midnight. However, at 150m very few copepods were found at mid-day and virtually none were found at other times of the day. (Table 16)

This data correlates with the theory that zooplankton (specifically copepods) are positively phototactic to an optimum light intensity. Theoretically the copepods rise to the surface at dusk, scatter and sink slightly at mid-night, rise to the surface again at dawn, and then sink during the day, following their optimum light intensity.

Table 16. Diurnal variation in zooplankton concentration.

Time (LMT):	0500		1100		1700		2300	
Depth (m)	Biomass (ml/m^3)	Copepods ($\#/m^3$)	Biomass (ml/m^3)	Copepods ($\#/m^3$)	Biomass (ml/m^3)	Copepods ($\#/m^3$)	Biomass (ml/m^3)	Copepods ($\#/m^3$)
10	0.053	43.8	0.012	0.92	0.054	20.4	0.028	3.1
150	0.020	0	0.014	1.90	0.018	0	0.016	0

5. Neuston Studies

Tarballs and Encrustation on Sargasso Weed

David Sloatman

Abstract

This project was designed to determine the effect of tarballs on the encrustation in the Sargasso weed community. The relative concentrations of tar and Sargasso weed from neuston tows were compared to the percentage of encrustation, the number of species encrusting, and the relative abundance of different types of encrusting organisms. The percentage of encrustation did not appear to be affected by the amount of tar found with the weed. The number of species encrusting did decrease when the tar concentration increased. The different types of encrusters each were affected differently by increased tar concentration. However, it was not possible to conclude that the observed variations were definitely a result of the presence of tar. (Table 17 and Figure 5)

Distribution of tarballs in relation to proximity of shipping lanes

Philip Round

Abstract

This project dealt with surface densities of pelagic tar along the cruise track of R/V Westward. Results obtained from towing a neuston net along the surface show that densities of tar were considerably higher in the proximity of the shipping lanes west of Cuba and south of the Florida Keys. (Table 17 and Figure 5)

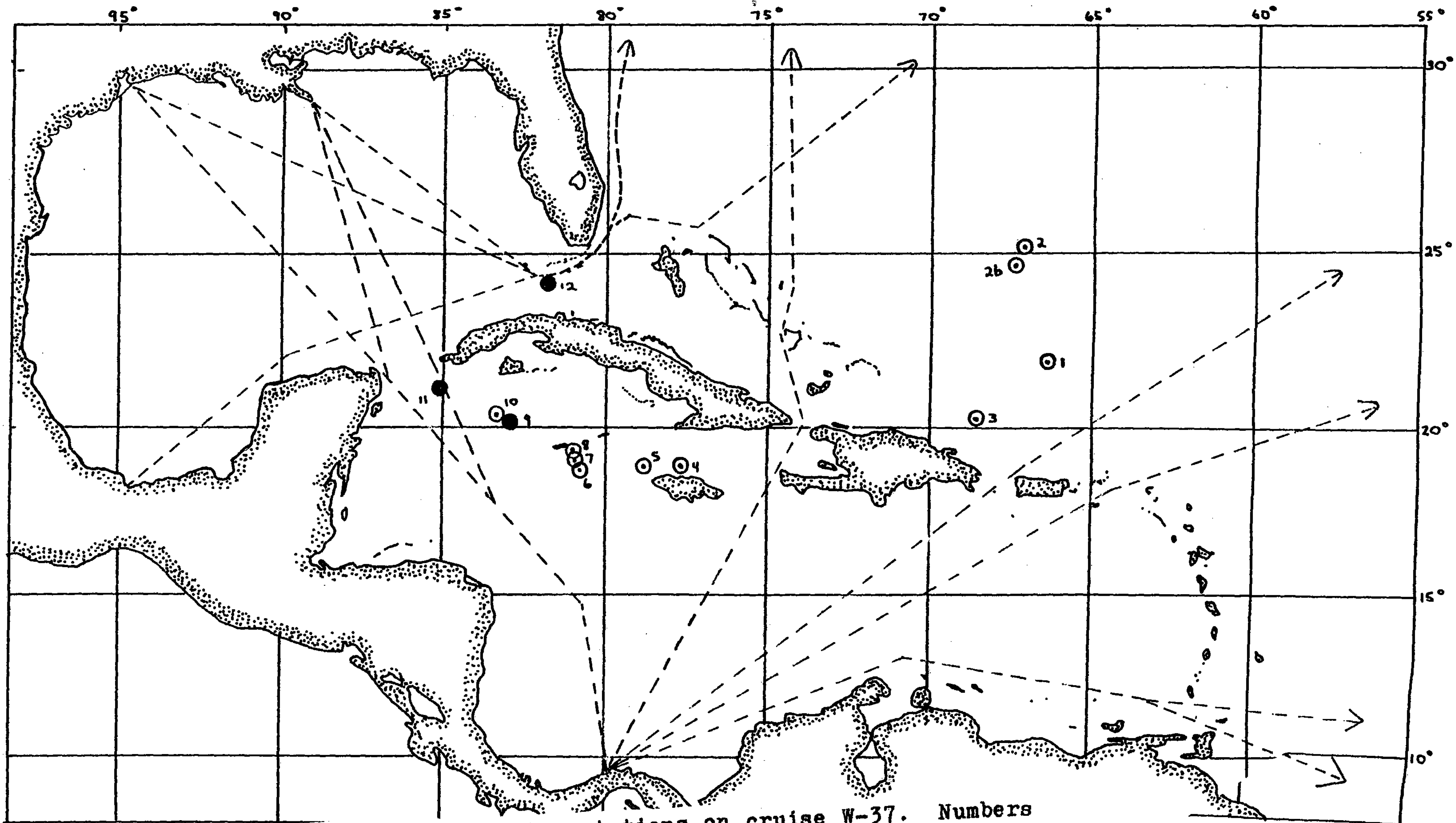


Fig. 5. Neuston tow stations on cruise W-37. Numbers correspond to stations listed in Table 15. Dashed lines represent shipping lanes. ● = tar content > 10 mg/m^2. ⊙ = tar content < 10 mg/m^2.

Table 17. *Sargassum*-tar results from the neuston tows. W-37.

Station	North Latitude	West Longitude	Weight of *Sargassum* (g)	Weight of Tar in Tow (g)	mg Tar/ m^2	g Tar/ g Weed	Encrustation (%)
1	22°31'	66°30'	0.5	0.08	<0.1	0.16	30
2	25°02'	67°03'	0.75	0.12	<0.1	0.17	60
2b	24°33'	67°30'	0.22	trace	<0.1	--	20
3	20°23'	68°49'	0	trace	--	--	0
4	18°53'	77°41'	0	0	--	--	--
5	18°54'	78°48'	123.0	1.2	0.5	0.01	25
6	18°51'	80°48'	0.08	0.3	0.5	4.00	0
7	19°05'	81°13'	0	trace	--	--	--
8	19°04'	81°12'	0	trace	--	--	--
9	20°07'	83°05'	53.1	23.25	10.3	0.44	40
10	20°16'	83°26'	9.45	1.2	0.5	0.13	5
11	21°14'	85°19'	22.05	9.9	17.6	0.45	50
12	24°20'	82°05'	1922.7	18.16	56.8	0.01	65

Biology of the *Sargassum* Fish, *Histrio histrio*: Preliminary Observations

Carl Baum

Abstract

The capture of a mating pair of *Sargassum* fish, *Histrio histrio*, in Caribbean waters east of Grand Cayman presented an unique opportunity to study fish behavior and general biology. These specimens measured roughly 7 cm. in standard length and, being docile creatures, adapted successfully to aquarium life.

During the month that these animals were kept in captivity, preliminary observations were made on their orientation in sargassum weed and general interactions with other *Sargassum* fauna; method of prey catching, food selection and cannibalism; modes of camouflage coloration; dexterity of their prehensile pectoral fins; change in respiration rate in response to aquarium and internal environments; temperature range tolerances; and courtship behavior and reproductive rate.

Additional opportunities to study this species in depth will be sought on future cruises.

6. Water Chemistry and Phytoplankton Diversity

Introduction

In an effort ot give some insight into the chemistry of the water in which we were working, to give our biological sampling an environmental backdrop and to round out the educational experience of the students, dissolved oxygen and reactive phosphorus were studied in some depth. The methods and results were considered extensively and presented to the entire group. The diversity of phytoplankton, the primary producers, was then studied and relationships between diversity, dissolved oxygen and reactive phosphorus were analysed. Oxygen and phosphate data are found in Figures 6 and 7. Phytoplankton data are presented in Table 18, and the positions of the hydrostations are found in Figure 8.

Phosphorus

Frank Helsell

Abstract

Phosphorus concentrations throughout the water column in the Sargasso Sea and the Caribbean Sea were compared. Hypothetically, phosphorus concentration is low at the surface, increases to the thermocline and then levels off. It has also been hypothesized that phosphorus concentration decreases during the day and increases at night. Water samples were collected by Nansen bottle at various depths, locations, and times of day. Phosphorus concentration was determined by spectrophotometry after treatment with a mixed reagent. No correlation was found between time of day and phosphorus concentration. There seemed to be more phosphorus in the Sargasso Sea than the Caribbean Sea. The phosphorus levels at Georgetown, Grand Cayman were particularly low, perhaps due to unusually severe storm-mediated mixing. The phosphorus levels at Key West, Florida were extremely high, possibly due to phosphate pollution from onshore sources. Generally, phosphorus concentration appears to increase gradually with depth until a maximum value is reached. Phosphorus concentration then decreases sharply to a minimum level, subsequently rising slightly.

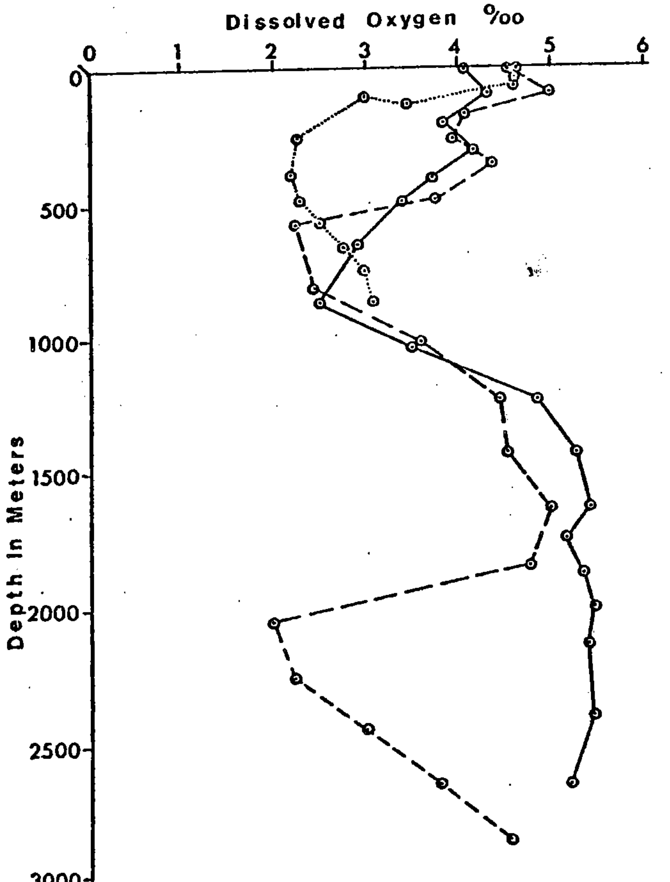


Fig. 6 Vertical profile of dissolved oxygen data. ——— = nansen cast 4. ---- = nansen cast 5. ····· = nansen cast 9.

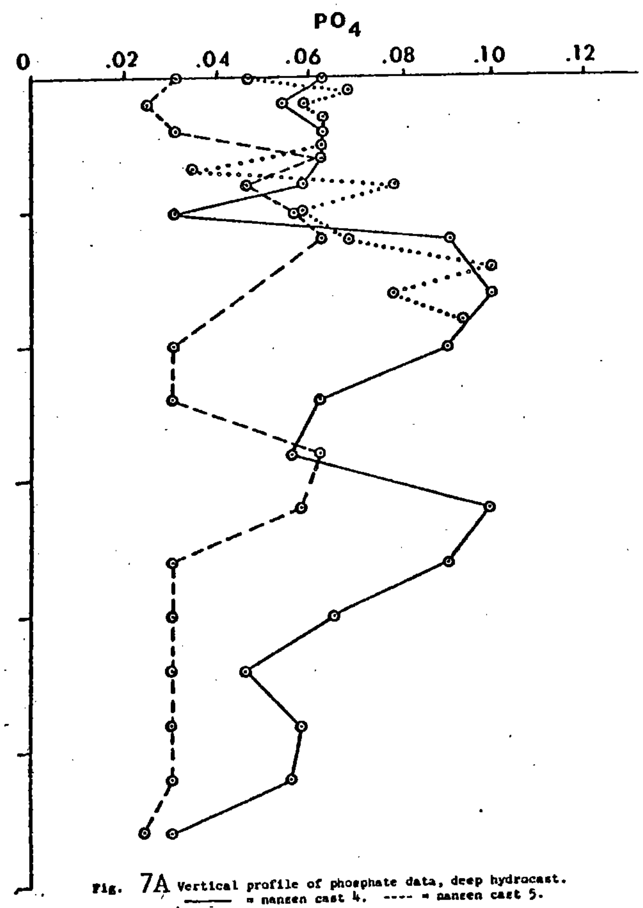


Fig. 7A Vertical profile of phosphate data, deep hydrocast. ——— = nansen cast 4. ---- = nansen cast 5. ······ = nansen cast 9.

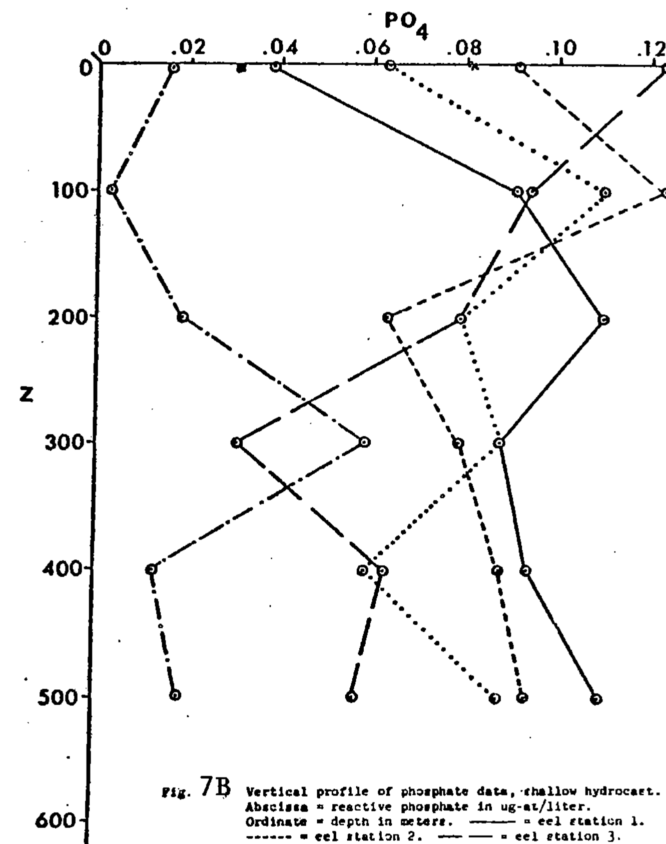


Fig. 7B Vertical profile of phosphate data, shallow hydrocast. Abscissa = reactive phosphate in ug-at/liter. Ordinate = depth in meters. ——— = eel station 1. ------ = eel station 2. —— —— = eel station 3. —·— = eel station 5. ······ = eel station 6. ● = Key West. ■ = Grand Cayman.

Dissolved Oxygen

Andy Puffer

Abstract

Dissolved oxygen profiles in the lower Sargasso Sea, the Cayman Trench in the Caribbean Sea, and the Straits of Florida were compared. Water samples were collected by Nansen bottle at depths throughout the water column and were analyzed by the modified Winkler method. In the Sargasso Sea dissolved oxygen concentration decreases with depth reaching a minimum of 2.3°/oo at approximately 850m and then increasing gradually to finally level off at approximately 5.5°/oo. The Caribbean Sea dissolved oxygen profile is similar to the Sargasso Sea profile except for a second pronounced minimum (2.3°/oo) at approximately 2000m. In the Florida Straits dissolved oxygen concentration decreased sharply at 75m reaching a broad minimum (2.2°/oo) at approximately 400m and then increasing slightly (to 3°/oo). The dissolved oxygen profiles are similar to those previously reported. However, the actual concentrations of dissolved oxygen are lower than those found by other investigators.

Phytoplankton Diversity

Amy Davidoff

Abstract

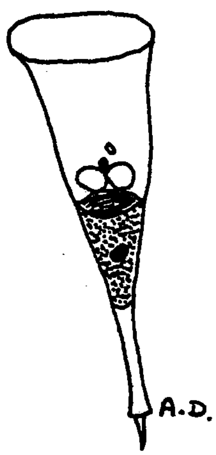
Phytoplankton was collected and speciated from areas within the Sargasso and Caribbean Seas. It has been found that the phytoplankton population in the Sargasso Sea is less diverse than in the Caribbean Sea. There is a definite increase in the number of genera as well as species within Caribbean waters. Samples were collected from just below the surface with a 0.3m phytoplankton net towed for one hour at a speed of one knot. The phosphate content of the water, salinity, and surface temperature were compared with the diversity of phytoplankton for each sample. No correlation could be found, and it is assumed that neither phosphate, salinity nor surface temperature were the limiting factor within these two water masses. The Sargasso Sea had a lower diversity than the Caribbean. This could explain why there is a smaller diversity of species in the higher trophic levels of the former water mass.

Table 18. Phytoplankton Studies

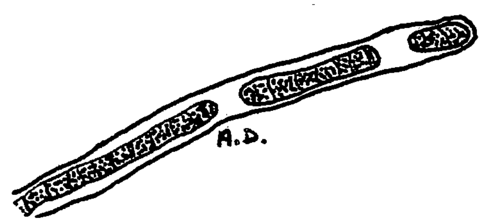
Station	# Species	Diversity*	T_s °C	S°/oo	PO_4 ug
E.S. 2	18	3.50	26.5	36.084	.091
E.S. 3	15	3.11	27.5	36.750	.125
E.S. 4 Deep cast #1	19	3.71	26.9	36.459	.063
E.S. 5	25	5.48	27.8	35.830	.016
E.S. 6	23	4.64	26.7	--	--

Diversity = S-1/ln N where S is # species and N is # individuals

E.S. = eel station



Xystonellopsis abbreviata



Lyngbya confervoides

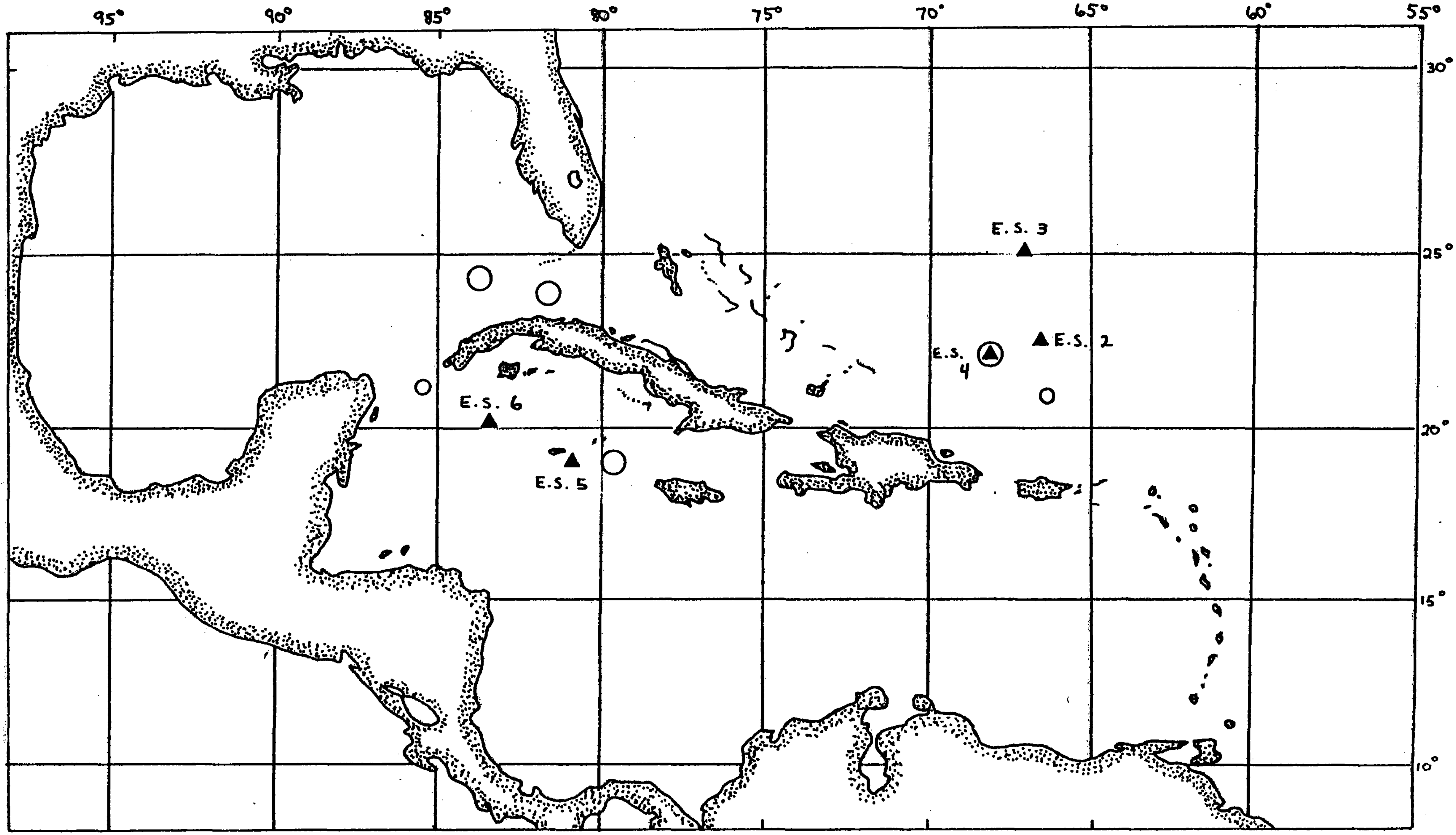


Figure 8. Hydrocast and phytoplankton tow stations. O = single cast. ◯ = multiple hydrocast. ▲ = phytoplankton tow and single hydrocast.

7. Reef Studies

Introduction

Coral reef ecology and geology formed a major part of the educational program during W-37. This was due partly to the desire to take full advantage of the Caribbean location of the cruise and partly due to the interests of the staff scientists on board.

Grand Cayman

Grand Cayman is a flat coral island protected from wind-driven waves by barrier/bank reefs and mangrove swamps. Due to a severe 'norther' which hit the Cayman Islands the evening of our arrival, all the reefs on the north and west sides of the island were unreachable. South Sound, on the protected southern side of the island, provided a classic example of a barrier/bank reef/lagoon ecosystem, and three days were spent making shell, coral/invertebrates, algae and fish rosters along a rough transect line (Tables 19, 20, and 21, and Figures 9 and 10.) and working on student projects.

Investigation of Sediments on South Sound Reef, Grand Cayman

Joan Gamble

Abstract

The dynamic reef ecosystem of South Sound, Grand Cayman was studied by researching one of the major processes involved in coral reef formation and destruction -- sedimentation. Eight sediment samples were taken along a transect line extending from the shore to the reef crest, along with temperature, current, turbidity, and other observations. The general sources of the sediments were deduced by measuring the percentage of organic material and the percentage of calcareous particles. As expected, the sediments were mostly calcareous, with a constant amount of organics, except in the *Thalassia* beds where more was found. The grain size distribution was studied and basically increased outward from shore, correlating well with currents observed on a calm day and with increasing distance from the beach.

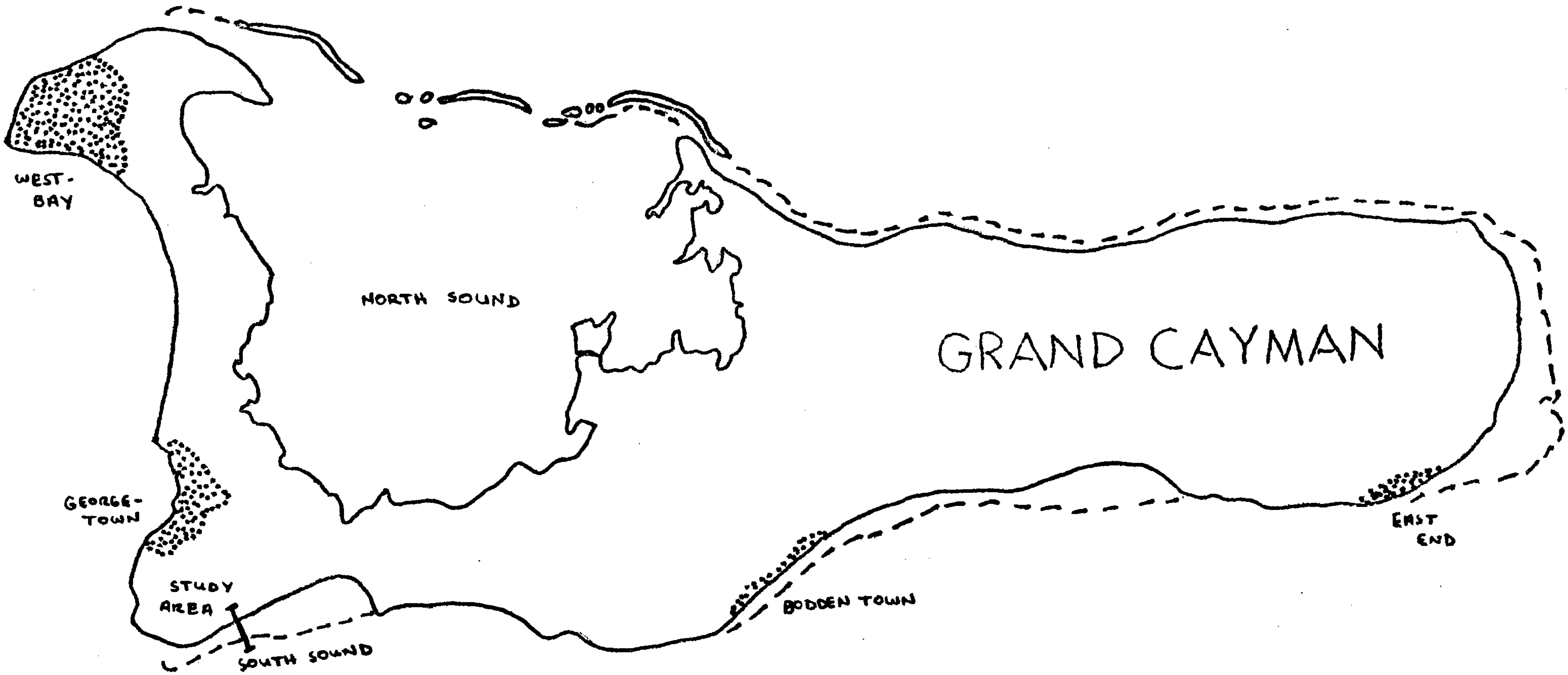


Fig. 9. Grand Cayman Island and W-37 Reef Studies I site. See Fig. 10 for study site enlargement.

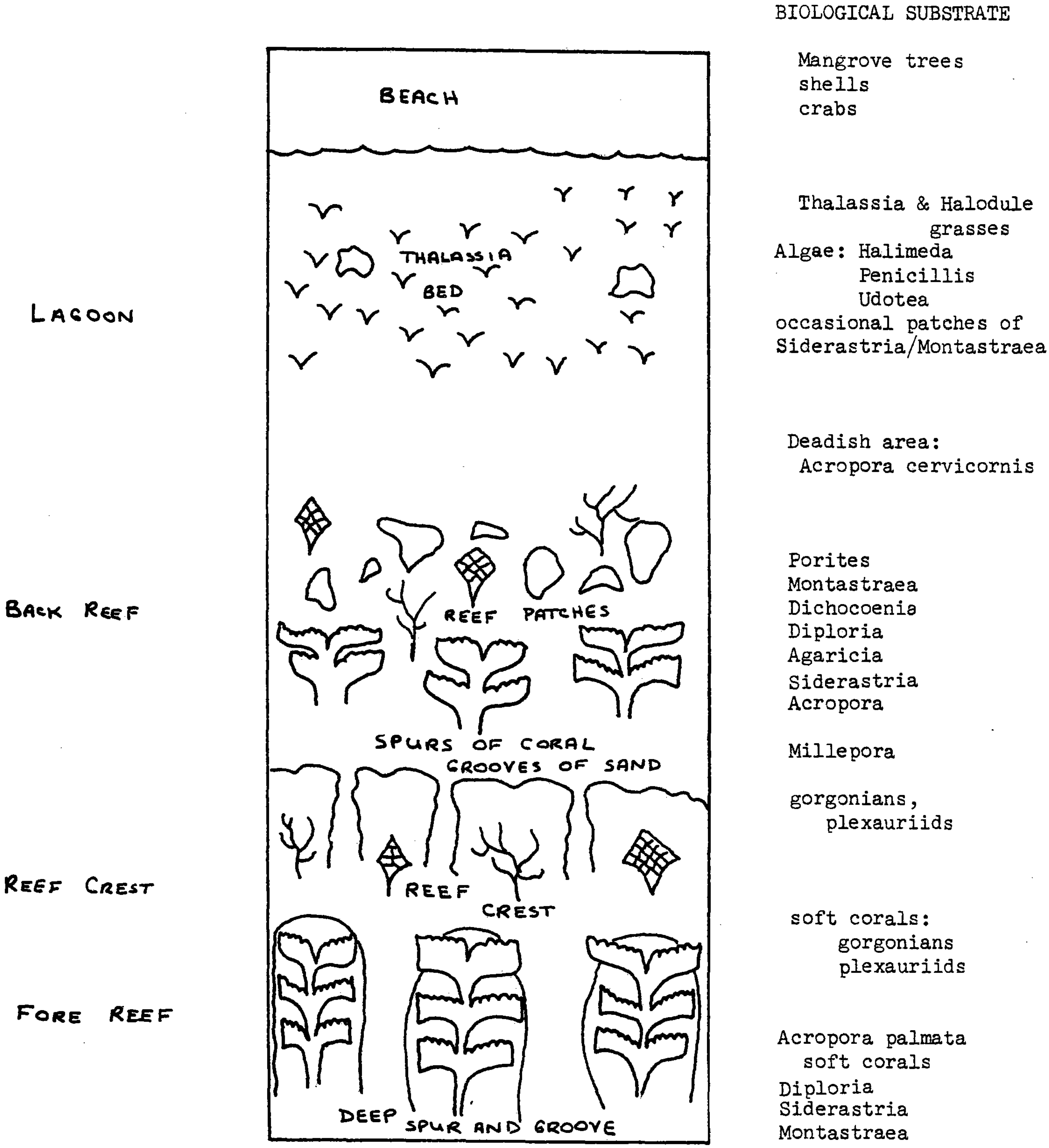


Fig. 10. South Sound transect, enlarged.

Table 19: Fishes of South Sound, Grand Cayman

Group: Squirrelfish - Family Holocentridae
- *Holocentrus rufus* (squirrelfish)
- *H. ascensionis* (Longjaw squirrelfish)
- *Adioryx vexillarius* (dusky squirrelfish)

Group: Sea Basses - Family Serranidae
- *Mycteroperca venenosa* (hellowfin grouper)
- *Epinephelus striatus* (Nassau grouper)
- *E. morio* (red grouper)
- *Gramma loreto* (fairy basslet)

Group: Grunts - Family Pomadasyidae
- *Haemulon album* (margate)
- *H. sciurus* (blue-striped grunt)
- *H. bonariense* (black grunt)
- *H. chrysargyreum* (smallmouth grunt)
- *H. macrostomum* (spanish grunt)
- *H. flavolineatum* (french grunt)
- *Anisotremus surinamensis* (black margate)
- *A. virginicus* (porkfish)

Group: Angelfish - Family Chaetodontidae
- *Holacanthus tricolor* (rock beauty)
- *H. ciliaris* (Queen angelfish)
- *H. bermudensis* (blue angelfish)
- *Centropyge argi* (cherubfish)
- *Pomacanthus paru* (french angelfish)
- *P. arcuatus* (gray angelfish)
- *Chaetodon ocellatus* (spotfin butterflyfish)
- *C. capistratus* (foureye butterflyfish)
- *C. striatus* (banded butterflyfish)
- *C. sedentarius* (reef butterflyfish)

Group: Damselfish - Family Pomadentridae
- *Chromis multilineatus* (brown chromis)
- *C. cyaneus* (blue chromis)
- *Abudefduf saxatilis* (sergeant-major)
- *Microspathodon chrysurus* (yellowtail damselfish)
- *Eupomacentrus partitus* (bicolor damselfish)
- *E. planifrons* (threespot damselfish)
- *E. fuscus* (dusky damselfish)
- *E. leucostrictus* (beaugregory)
- *E. variabilis* (Cocoa damselfish)
- *Eupomacentrus* sp. (honey damselfish)

Group: Hawkfish - Family Cirrhitidae
- *Amblycirrhitus pinos* (redspotted hawkfish)

(continued)

Group: Wrasses - Family Labridae
- Bodianus rufus (spanish hogfish)
- Thalassoma bifasciatum (bluehead)
- Clepticus parrai (creole wrasse)
- Hemipteronotus splendens (green razorfish)
- Halichoeres maculipinna (clown wrasse)
- H. poeya (blackear wrasse)
- H. bivittatus (slippery dick)
- H. garnoti (yellowhead wrasse)
- H. radiatus (puddingwife)

Group: Parrotfish - Family Scaridae
- Scarus vetula (queen parrotfish)
- S. taeniopterus (princess parrotfish)
- S. croicensis (striped parrotfish)
- S. guacamaia (rainbow parrotfish)
- S. coeruleus (blue parrotfish)
- S. coelestinus (midnight parrotfish)
- Sparisoma viride (stoplight parrotfish)
- S. chrysopterum (redtail parrotfish)
- S. aurofrenatum (redband parrotfish)
- S. rubripinne (yellowtail parrotfish)

Group: Jawfish - Family Opistognathidae
- Opistognathus whitehurstii (dusky jawfish)

Group: Combtooth blennies - Family Blenniidae
- Ophioblennius atlanticus (redlip blenny)

Group: Clinids - Family Clinidae
- Malacoctenus triangulatus (saddled blenny)
- Hemiemblemaria simulus (wrasse blenny)
- Labrisomus nuchipinnis (hairy blenny)

Group: Scorpionfishes - Family Scorpaenidae
- Scorpaena plumieri (spotted scorpionfish)

Group: Tarpons - Family Elopidae
- Megalops atlanticus (tarpon)

Group: Trunkfishes - Family Ostraciontidae
- Lactophrys trigonus (trunkfish)
- L. triqueter (smooth trunkfish)

Group: Surgeonfishes - Family Acanthuridae
- Acanthurus coeruleus (blue tang)
- A. chirurgus (doctorfish)
- A. bahianus (ocean surgeon)

(continued)

Fishes of South Sound, Grand Cayman (cont.)

Group: Filefishes - Family Balistidae
- Melichthys niger (black durgon)
- Alutera schoepfi (orange filefish)
- A. scripta (scrawled filefish)
- Cantherhines pullus (orange spotted filefish)

Group: Tilefishes - Family Branchiostegidae
- Malacanthus plumieri (sand tilefish)

Group: Trumpetfishes - Family Aulostomidae
- Aulostomus maculatus (trumpetfish)

Group: Sea basses - Family Serranidae
- Cephalopholis fulva (coney)

Group: Sweepers - Family Pempheridae
- Pempheris schomburgki (glassy sweeper)

Group: Snappers - Family Lutjanidae
- Ocyurus chrysurus (yellowtail snapper)

Group: Spadefishes - Family Ephippidae
- Chaetodipterus faber (atlantic spadefish)

Group: Goatfishes - Family Mullidae
- Mulloidichthys martinicus (yellow goatfish)

Group: Left-eye flounders - Family Bothidae
- Bothus lunatus (peacock flounder)

Group: Whiptail stingrays - Family Dasyatidae
- Dasyatis americana (southern stingray)

Group: Needlefishes - Family Belonidae
- Strongylura notata (redfin needlefish)

Group: Moray eels - Family Muraenidae
- Gymnothorax funebris (green moray)

Group: Barracudas - Family Sphyraenidae
- Sphyraena barracuda (great barracuda)

Group: Jacks - Family Carangidae
- Caranx ruber (Bar Jack)
- C. latus (horse-eye jack)
- C. fusus (blue runner)

Reef Development along the Back Reef, South Sound, Grand Cayman

Deborah Lieberman

Abstract

Reefs strive to maintain balance with the dominant physical processes to which they are exposed, although ultimately morphological and biological variability of reefs involves a plexus of interactions between chemical, biological and physical parameters. Wave energy has long been recognized as one of the important controls of coral growth and reef development. On the South Shore off Grand Cayman several patch reefs were observed adjacent to the lagoons, in the lee of the reef crest. During the four days of reef studies (December 23-26) the morphology and surrounding environmental conditions were observed in an attempt to determine whether these patch reefs were degenerating as a result of being positioned in a low energy environment. Current studies revealed that longshore currents as well as tidal currents ran across the back reef, thus supplying the necessary nutrients. The temperature ranges across the reef were fairly normal, and sediments remained at a minimum. There was no apparent reason for the large amount of dead coral observed. A general lack of Acropora palmata and Millepora species indicates that these patch reefs will not be expanding, but instead either will degenerate into a corraline/algae pavement or be reduced to a community of still water corals. Wave activity isn't sufficient to form an algal ridge. These patch reefs are by no means dying but instead are metamorphosing into an ecosystem that is balanced due to the environmental conditions surrounding it.

Table 21. Algae of South Sound, Grand Cayman

Species	Turtle grass	Back Reef	Reef Crest	Fore Reef
Phylum Chlorophyta				
Halimeda sp.	*	*		
Penicillus sp.	*	*		
Udotea sp.	*	*		
Chaetomorpha sp.	*			
Acetabularia sp.		*		
Valonia sp.		*	*	
Neomerus annulata		*	*	
Caulerpa sp.		*		
Phylum Phaeophyta				
Padina sp.		*	*	
Dictyota sp.		*	*	
Dictyopleus sp.		*	*	
Sargassum sp.		*		
Phylum Rhodophyta				
Galaxura sp.		*	*	
Liagara sp.		*	*	
Coelothrix sp.		*	*	*
Ceramnium sp.		*	*	*
Chondrus sp.		*		
Jania sp.			*	
Neogoniolithon sp.		*	*	*
Lithophyllum sp.		*	*	*
Amphiroa sp.		*	*	*
Porolithon sp.		*	*	*

Table 20: Coral Species Roster - Grand Cayman (South Sound)

Order Scleractinia: (hard corals)	Acropora palmata (elkhorn) A. cervicornis (staghorn) Porites porites (finger) P. astreoides (mustard hill) Diploria strigosa (smooth brain) Dichocoenia stokesii (flower) Agaricia agaricites (leaf) Montastraea annularis (mountainous star) Siderastria siderea (starlet)
Order Gorgonacea: (soft corals)	Plexaura flexuosa (sea rod) Gorgonia ventalina (common sea fan) Plexaura homomalla (black sea rod) Eunicea calyculata (warty eunicea) Pterogorgia citrina (yellow sea whip) Briareum asbestinum (corky sea fingers)
CLASS HYDROZOA: (so-called "fire corals", not really corals at all)	Millepora alcicornis (encrusting fire) Millepora complanata (leafy fire)

Fish Diversity around Grand Cayman

Philip Rogers

Abstract

Fish species diversity in six zones of a section of Grand Cayman reef was compared. Diversity was lowest in the Thalassia zone, significantly higher in the lagoon zone and greatest in the patch reef zone. The back reef zone was also high in diversity, but the fish were of larger size and schooling varieties. The reef crest zone had somewhat lower diversity and seemed to be used as a feeding area for many of the species found in the patch reef and back reef zones. The off-reef zone had even lower diversity and larger, pelagic species. Most of the fish of a species seemed to establish "home territories" in a particular zone and an extended feeding area that sometimes crossed into another zone. Very few fish species were truly cosmopolitan, occurring throughout the reef.

Loggerhead Key

Loggerhead Key is the largest of the islands in the Dry Tortugas, off the southwest edge of Florida. The Dry Tortugas themselves are extensions of the lower keys and like the lower keys are coral overlying limestone and basalt. The islands in the group are surrounded by sand and coral patches, primarily Montastraea heads, intersperced with gorgonians. Because the Tortugas are protected by the U.S. Government, the flora and fauna are allowed to grow unmolested by man. The results of this protection are apparent in the diversity of fish and the number and size of some of the invertebrates, particularly the sea urchin Diadema antillarum and the spiny lobster Panulirus argus. All in all, the area provided fine material for comparison studies with the reef at Grand Cayman and for a few isolated projects and rosters. (Figure 11 and Table 22.)

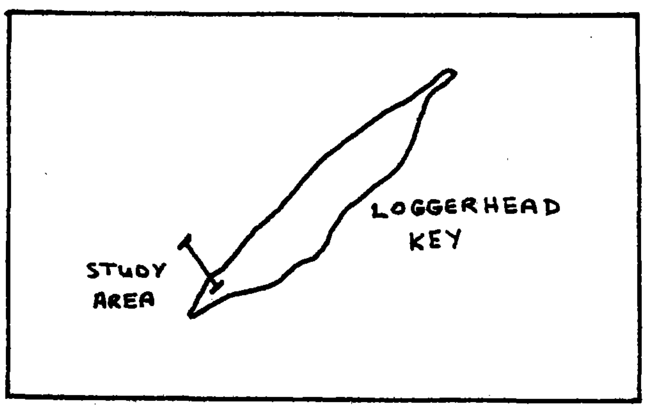


Fig. 11. Loggerhead Key, with W-37 Reef Studies II site delineated.

Table 22 : Dry Tortugas - Coral and Invertebrates

Stony Corals:	Acropora cervicornis	(staghorn)
	Porites porites	(finger)
	P. astreoides	(mustard hill)
	Diploria clivosa	(knobbed brain)
	D. strigosa	(smooth brain)
	D. labrynthiformis	(brain)
	Montastraea annularis	(star)
	M. cavernosa	(large star)
	Dichocoenia stokesii	(star)
	Siderastrea siderea	(starlet)
	Agaricia agaricites	(leaf)
	Eusmilia fastigiata	(flower)
Soft Corals:	Plexaura flexuosa	(sea rod)
	Eunicea sp.	(eunicea)
	Pseudopterogorgia acerosa	(purple sea plume)
	Gorgonia ventalina	(common sea fan)
Hydrozoans:	Millepora alcicornis	(stinging coral)
	M. complanata	(fire coral)

How Physical Elements affect the Growth and Diversity of Coral Patch Reefs

Sylvia Wolf

Abstract

Two patch reefs, one in Grand Cayman, British West Indies, and the other in Loggerhead Key, Florida, were examined to determine how physical factors affect coral diversity and growth. This study involved the measurement of light intensity, currents and temperature as well as the observation of weather, turbidity, sedimentation, the geology of the area and coral species of the two patch reefs. These factors indicated that Grand Cayman patch reefs have more favorable conditions and therefore should be healthier and have more diversified species than Loggerhead Key. In fact, the reverse seemed to be true. It was suggested that nutrients, and possibly oxygen and salinity, are crucial elements in the study of those two reefs and that all three elements must be explored and researched before an accurate protrait of the reefs is made.

The Success of Algae in the Competition for Reef Surface Space

Jack J. Boltax

Abstract

The coral reef is a community in a constant state of flux, being concurrently built up and destroyed by various physical and biological factors. When a surface is stripped of its coral growth a succession of rapid settlers attempts to colonize it. Algae are the most rapidly growing colonizers of free surface. Thus, it would be expected that next to the coral, algae should be the most abundant organisms on dead coral surface. Furthermore, encrusting algae should dominate in an extensively developed reef. Transects on Grand Cayman and Loggerhead reefs supported this hypothesis. Encrusting red algae dominated the spur and groove fringing reef at Grand Cayman, and the fleshy calcareous algaes dominated the lesser developed patch reef at Loggerhead Key.

Damselfish Territoriality

Carol Knowles

Abstract

This study was designed to investigate the territorial behavior of the Damselfish (Pomacentridae). Mirrors were used to simulate the intrusion of one damselfish into the territory of another. No response was elicited from the Yellowtail Damselfish (*Microspathodon chrysurus*) and only slight response from the Dusky Damselfish (*Eupomacentrus dorsopunicans*).

Feeding Behavior of Reef Fishes

Carol Knowles

Abstract

Several sea urchins (*Diadema antillarum*) were cracked open in an attempt to observe feeding behavior of a group of fishes on one food source. Bluehead wrasse (*Thalassoma bifasciatum*) were consistently first to arrive, followed by slippery dicks (*Halichoeus bivattatus*), grunts (Pomadosyidae) and yellowtail snappers (*Ocyurus chrysurus*), in that order. Larger fish often chased away smaller ones but the smaller fish persistently returned until the food was gone.

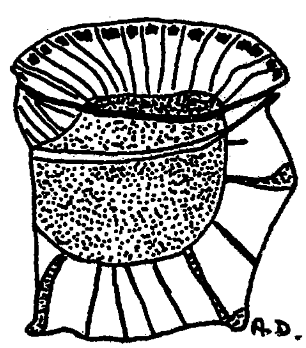
8. Psychobiology

Expectations and Realities of Life at Sea

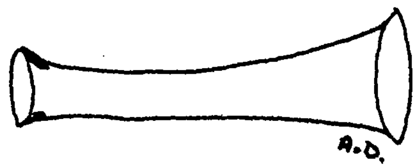
Wendy Cohn

Abstract

An attempt was made to measure the differences between expectations and realities of life at sea by comparing the occurrence of key phrases in essays written before joining the Westward and essays written after four weeks on board. Hypothetically, males more accurately predict physical strains of life at sea while females more accurately predict psychological changes. Males apparently experienced unexpected psychological changes; females experienced expected psychological changes. Information regarding males' expectations of physical strain of life at sea was inconclusive. Half of the females who expected life at sea to be physically straining found it to be so.

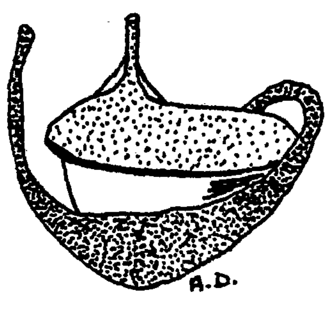


Ornithocercus steini



Eutintinnus sp.

APPENDICES



Ceratium gibberum

Appendix 1

Bathythermograph log. W-37.

BT#	Date	LMT	North Latitude	West Longitude	Surface Temperature (°C)	
1	12/1	1700	19°18'	66°18'	27.5	
2	12/1	1830	19°32'	66°21'	27.4	
3	12/1	2000	19°47'	66°22'	27.3	
4	12/1	2200	19°55'	66°23'	27.2	
5	12/2	0400	20°30'	66°26'	26.7	
6	12/2	0545	20°40'	66°26'	26.7	
7	12/2	0720	20°51'	66°26'	26.8	
8	12/2	1110	21°00'	66°37'	27.2	
9	12/2	1526	21°12'	66°38'	27.1	
10	12/2	1712	21°19.6'	66°36'	26.9	
11	12/2	1920	21°32.5'	66°34'	26.9	
12	12/2	2110	21°39'	66°42'	26.8	
13	12/2	2300	21°45'	66°42'	26.8	
14	12/3	0220	21°55'	66°35'	26.7	
15	12/3	1305	22°28.5'	66°25'	26.8	
16	12/5	1222	24°58'	67°02'	26.3	
17	12/8	0225	22°04'	68°05'	26.9	
18	12/20	1450	18°53'	80°53'	27.8	
19	12/27	2010	20°26'	83°32'	26.9	
20	12/28	1800	21°01'	85°24'	26.7	
21	12/30	2300	24°00'	84°50'	22.6	
22	12/31	0820	24°20'	83°32'	23.0	
23	12/31	1720	24°21'	83°43'	23.2	
24	12/31	1930	24°14'	83°40'	23.2	
25	12/31	2115	24°14'	83°36'	23.3	invalid
26	12/31	2230	24°07'	83°39'	23.0	invalid
27	1/1	0030	24°05'	83°35'	22.9	invalid
28	1/1	0100	23°58'	83°31.5'	22.9	invalid
29	1/1	0115	23°49'	83°31'	23.3	
30	1/1	0230	23°42'	83°29'	23.6	
31	1/1	0345	23°38'	83°26.5'	24.2	
32	1/1	0425	23°84'	83°24'	25.8	
33	1/1	0535	23°29'	83°22'	26.2	
34	1/1	0630	23°24'	83°21'	26.0	
35	1/1	1730	23°50'	82°39'	24.7	
36	1/9	1310	23°55'	81°44'	25.8	

Appendix 2

Acoustic station log. W-37.

	Date	Time	North Latitude	West Longitude	Pos/ Neg	Species	Remarks
1.	12/10	1530-1630	21°02'	68°55'	Pos	Megaptera noviangliae	Distant sounds identified with moderate assurance.
2.	12/11	1530-1540	19°59'	68°51'	Neg	-	1-2 miles from last sight of 30-ft humpback.
3.	12/12	0530-0615	19°54'	68°50'	Pos	M. noviangliae	Moaning + series of clicks, about 2/min.
4.	12/12	1700-1720	20°10'	68°50'	Neg	-	Edge of Navidad Bank; 2 hydrophones deployed.
5.	12/13	1200-1215	20°03'	68°50'	Neg	-	Sea surface noise.
6.	12/16	1430-1830	19°23'	74°15'	Pos	Physeter catodon	Sharp clicks at varying intervals; whales surfacing close to ship