CRUISE REPORT

W-62

Scientific Activities

Woods Hole - Guantanamo Bay - Montego Bay - Cozumel - Miami

03 February - 17 March 1982

R/V <u>Westward</u>

Sea Education Association

Woods Hole, Massachusetts

SHIPBOARD DRAFT

PREFACE

The objective of this report is to compile the data collected on the sixty-second cruise of the research vessel Westward, which took place between 03 February and 17 March 1982. Included are the abstracts from 23 student projects completed and written during the cruise. Also included are data being incorporated in the long-term studies of SEA staff scientists and associated researchers.

Much of the scientific success of the cruise was due to the skillful maneuvering of the ship (frequently against impossible headwinds) by a talented Nautical Science staff. Captain Carl Chase not only kept us closer to our schedule than seemed conceivable, at times, he also livened our low moments with magic rhythms, making music with the unlikeliest of tools. Chief Mate Gayle Biddle and Mates Phil Sachs and Art Pearson provided the navigation and seamanship needed to run arduous oceanographic stations at sea; Engineer Gregg Swanzey kept the engine room immaculate and was always ready to help with analytical instruments in the lab. Delicious - and often surprising - food arrived with consistency from Malinda Jones's galley.

Assistant Scientists Diane Eskenasy and Jim Koehler worked hard to keep the science program going. Diane extended her area of expertise beyond geology this trip and together with Jim provided very fine maintenance of lab and equipment, freeing me for coordination of the many stations required to accomplish the various research goals of students and scientists.

Visiting Scientists Tim Rumage and Amelia Giordano both studied marine mammals, but from two entirely different perspectives. Tim was on board to return to Navidad Bank to study and observe the humpback whale; Amelia came to study dolphins. Tim was on the first leg, Amelia on the last, nicely balancing these aspects of our work.

Also visiting were Harry Hart on the second leg and Ralph Parker on the last leg. Each contributed to the success of the cruise and to its value for each of us.

I wish to thank the staff, the visitors, and certainly the students for their participation and for the invaluable contributions they all made to the cruise.

Mary W. Farmer
Chief Scientist
W-62

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INTRODUCTION

This cruise report provides a record of the scientific research activities conducted aboard the R/V Westward during the laboratory section of the Introduction to Marine Science course NS225 at Boston University. The cruise track (figures 1 and 2) was designed to study (1) a major current that is part of the North Atlantic gyre circulation system, (2) a shallow bank that is part of the calving grounds for the humpback whale, and (3) the Caribbean Sea. The ship's itinerary (table 1) permitted W-62 participants direct access to tropical terrestrial and reef habitats in addition to the open ocean environment. Cruise participants are listed in table 2.

The major portion of research was accomplished through the design and execution of individual projects directed toward the topics listed as well as long-term studies conducted by SEA. These projects were completed while the students were still aboard, and the abstracts of their reports comprise the bulk of this volume.

Research conducted during W-62 also represented the 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.

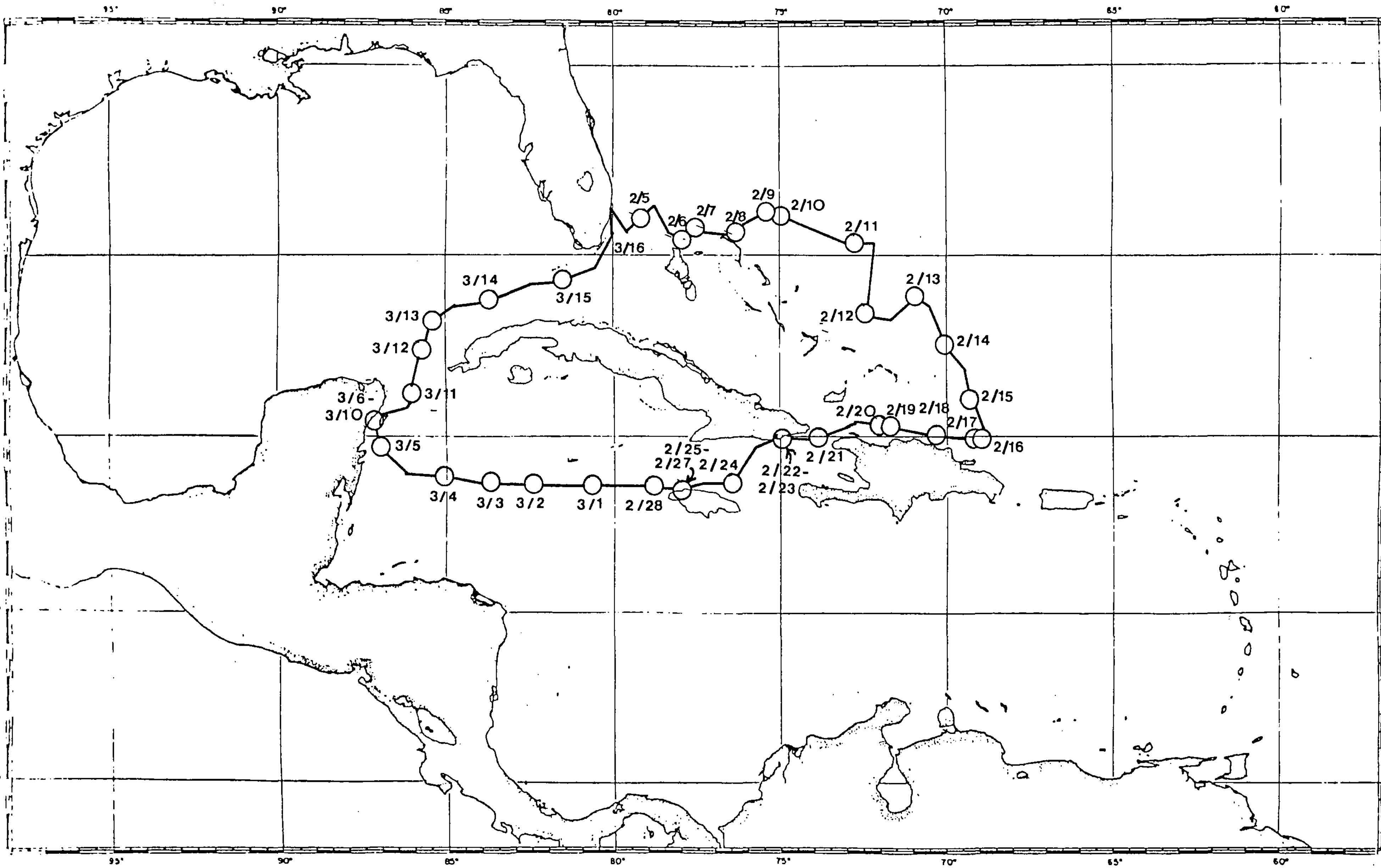


Figure 1. Cruise track for cruise W-62 of the R/V Westward. Circles and dates = noon position.

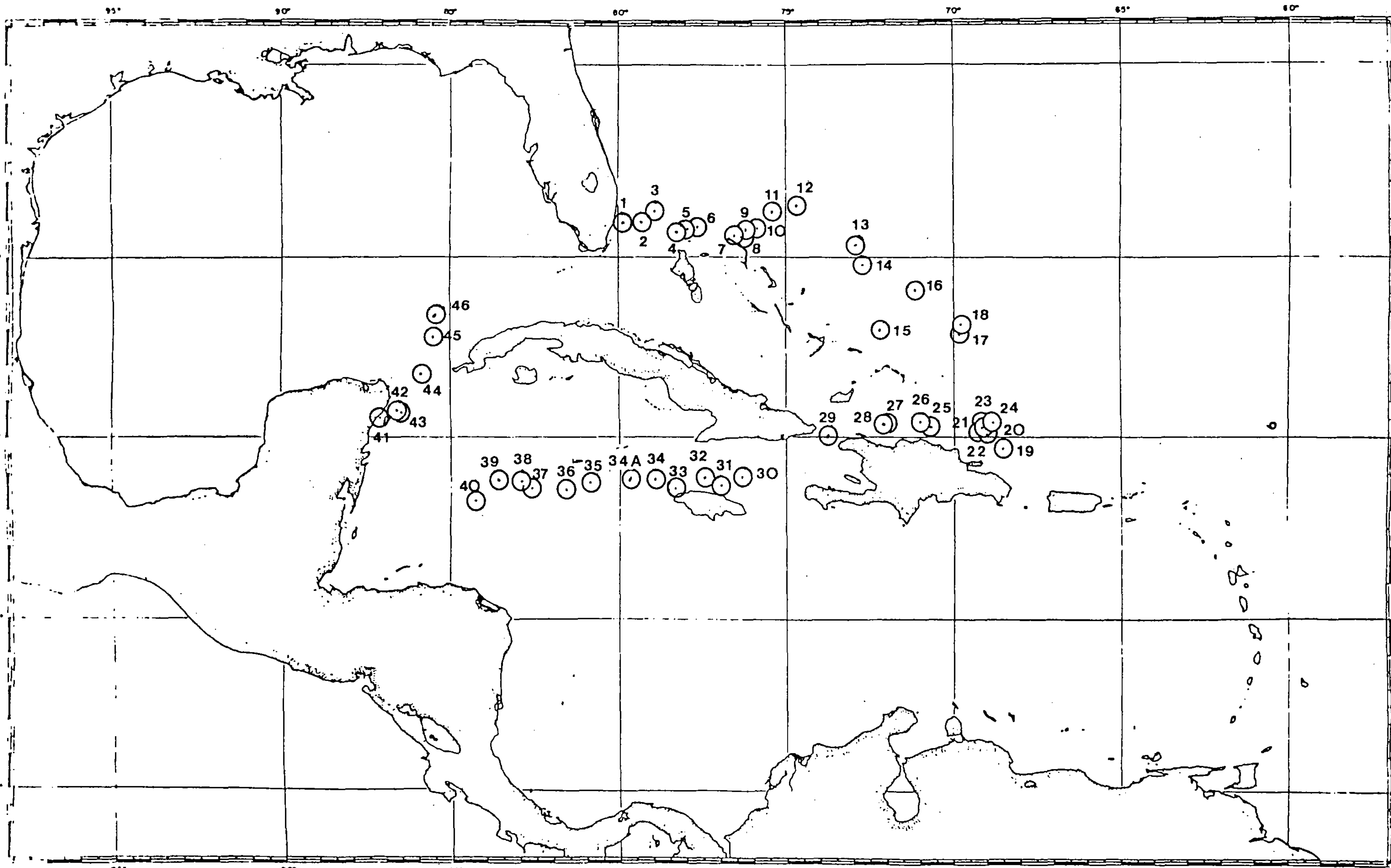
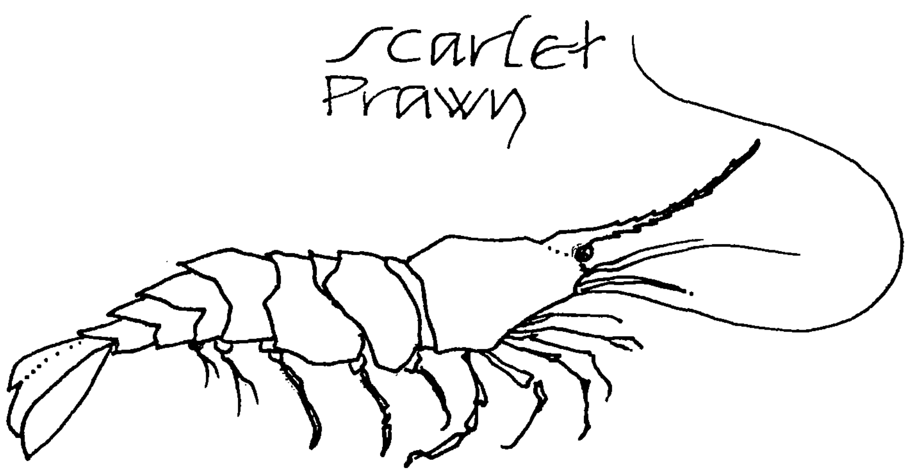


Figure 2. Reference map of stations done on cruise W-62. Procedures done at each station given in Appendix I.

Table 1. Itinerary and port stops for cruise W-62.

Port or location	Arrive	Depart
Miami, Florida	-	04 February 1982
Navidad Bank		
Guantanamo Bay, Cuba		
Montego Bay, Jamaica		
Cozumel, Mexico		
Miami, Florida	16 March 1982	



Illustrations
by Jane Maybank

Table 2. Ship's complement for cruise W-62.

Nautical Staff

Carl A. Chase, Ocean Operator	Captain
Barbara Gayle Biddle, Ocean Operator	Chief Mate
Phil A. Sachs, Ocean Operator	Second Mate
Arthur N. Pearson, Inland Operator	Third Mate
Gregg H. Swanzey, Ocean Operator	Chief Engineer
Malinda Jones, Food Services	Steward

Scientific Staff

Mary W. Farmer, Ph.D., Biological Oceanography	Chief Scientist
Diane M. Eskenasy, M.S., Geological Oceanography	Assistant Scientist
James E. Koehler, B.S., Coastal Oceanography	Assistant Scientist

Visiting Scientists and Scholars

Timothy Rumage III, M.S., Curator, Natural History Museum, R.I.S.D.
Harry Hart, Former Headmaster, Chapel Hill-Chauncy Hall School
Amelia Giordano, Universite d'Aix-Marseille, Station Marine d'Endoume et Centre d'Oceanographic
Ralph Parker, Outward Bound, Santa Fe

Students

Randal S. Bouchard, Senior, Cornell University
Elizabeth S. Briggs, Junior, Middlebury College
Maryann V. Buehler, Sophomore, Wesleyan University
Kenneth A. Carle, Senior, Hobart College
Eugene P. Carletta, Senior, Boston University
Christopher G. Carter, Junior, University of California/Berkeley
Christina A. Douglas, Junior, Cornell University
Elizabeth V. Edmonds, Sophomore, Stanford University
Michael E. Farber, Junior, Union College
Barbara E. Jacobs, Junior, Notre Dame University
David K. Jenkins, Junior, University of Richmond
Ingrid A. MacFarlane, B.A., Colby College
Keith G. Mansfield, Junior, Cornell University
Jane H. P. Maybank, Junior, Sarah Lawrence College
Dan P. McKee, Junior, Beloit College
Mark A. Murray-Brown, Senior, Bates College
Judith M. O'Neil, Junior, Boston College
Rebecca B. O'Sullivan, Sophomore, Bennington College
Geoffrey F. Patton, Senior, Cornell University
Lisa C. Pritchard, Junior, University of Vermont
Randi H. Rosenthal, Junior, Boston University
Drew B. Schembre, Junior, Middlebury College
Robert S. Skoglund, Senior, Bethel College
Mark F. Underwood, Senior, Beloit College

ANTILLES CURRENT STUDIES

Introduction

The Antilles Current is part of the gyre system of ocean circulation in the North Atlantic, of which the Gulf Stream is the most conspicuous feature. It is fed by the westward-flowing North Equatorial Current, which splits into two sections when it reaches the eastern Caribbean (figure 3). Part of the equatorial current flows through the Caribbean, into the Gulf of Mexico and finally through the Florida Straits, where it becomes the Gulf Stream proper. Another section of the equatorial current branches north rather than entering the Caribbean. This section becomes the Antilles Current, which flows past the eastern edge of the Bahama Platform. North of the Bahamas, the Antilles Current joins the Gulf Stream and the two currents merge (figure 3).

The cruise track for W-62 took the Westward through a cut (the Providence Channel) in the Bahamas Platform that runs between the Gulf Stream and the Antilles Current. The first sighting of frigate birds was made in the Providence Channel, where the birds were soaring over a surface slick and windrow of *Sargassum* weed. A bathythermograph (BT) profile was begun and the second BT was lowered into a second surface slick. The final BT transect consisted of a cross-section through that second slick in the Providence Channel and shows a thermal front to the left (south) of the slick (figure 4). A transect later in the season across the Providence Channel also showed a thermal front, but there was no evidence of slicks associated with that profile (figure 5). These two BT transects were done on different space scales; in February the entire cross section was 3 miles across whereas the one in March was 50 miles across. Yet both profiles show that the water in the Providence Channel is complex. It is not a simple, uniform body of water flowing, say, directly from the Antilles Current to the Gulf Stream. Rather, it seems to contain thermal features on several scales that may include the effects of nearby land masses, local upwelling, tidal flow, bathymetric contours, and other factors that influence current flow and mixing.

The Antilles Current itself was by contrast a more nearly uniform body of water and could be distinguished from Bahamian Shelf

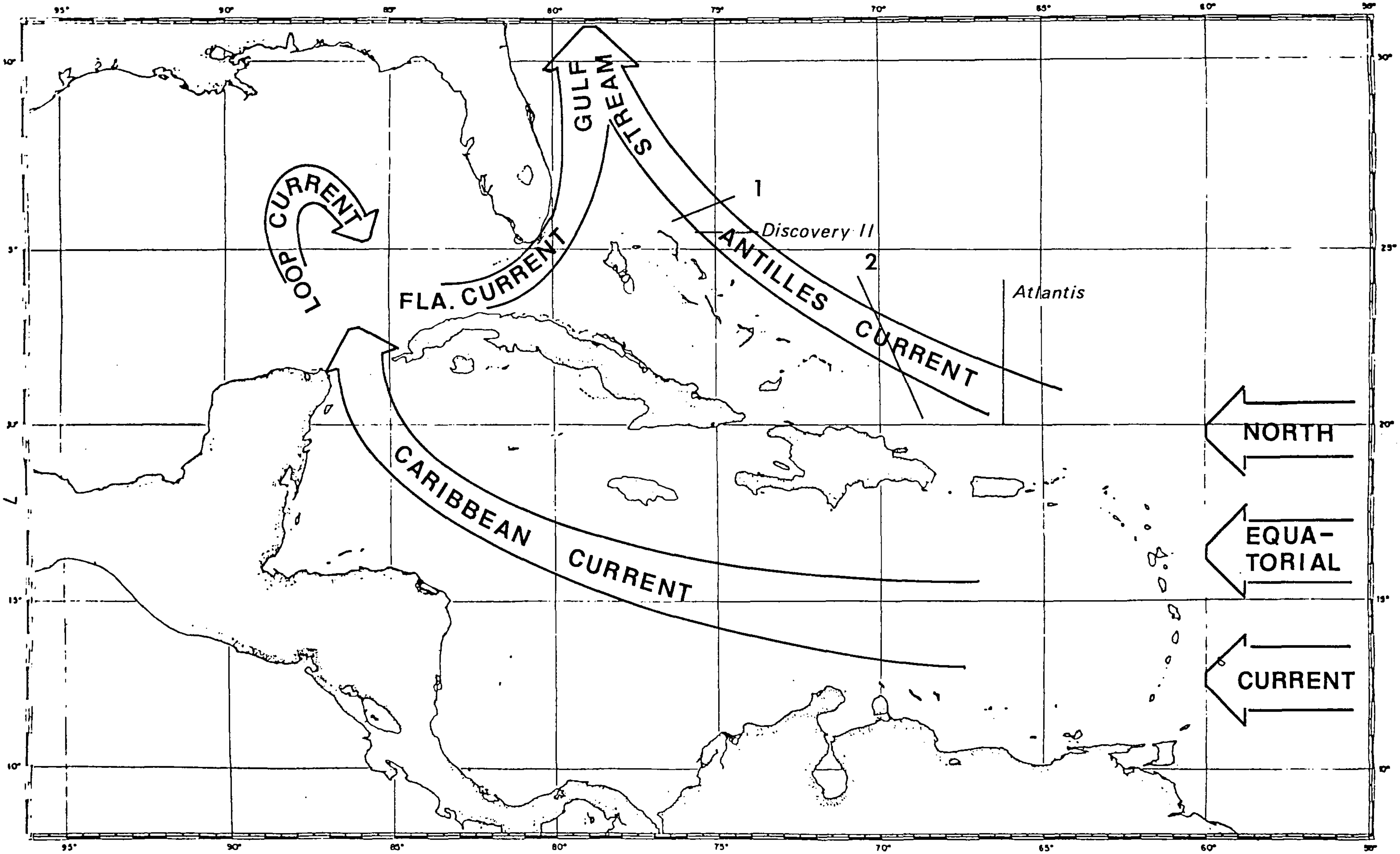


Figure 3. Simplified general surface circulation pattern in the region of cruise W-62. Transect lines (1) and (2) performed by the R/V Westward. Comparisons made with transects by the Discovery II and the Atlantis as reported in the literature.

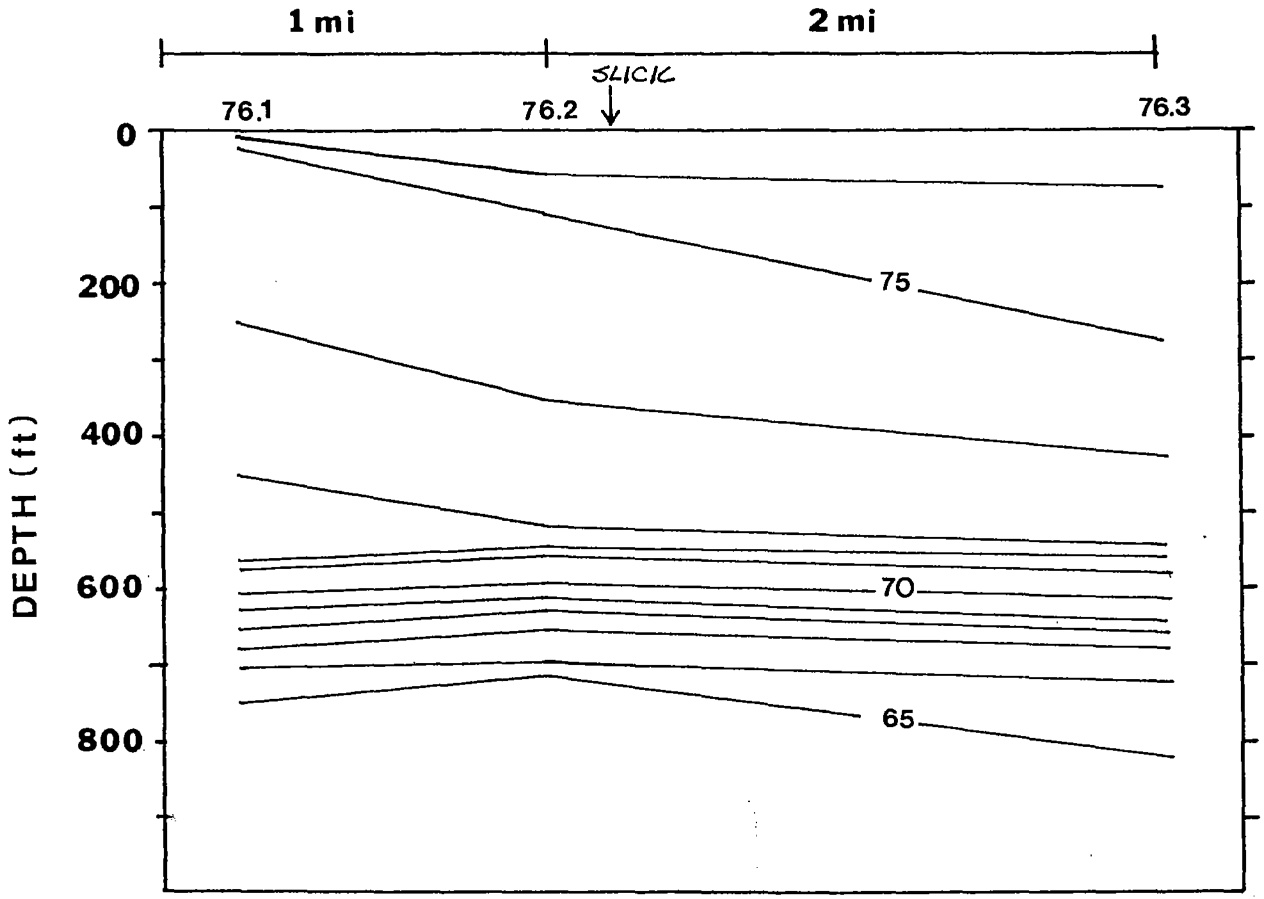


Figure 4. Bathythermograph profile across a slick in the Providence Channel. Depth in feet, temperatures in °F. Numbers at the top of the graph = surface temperature.

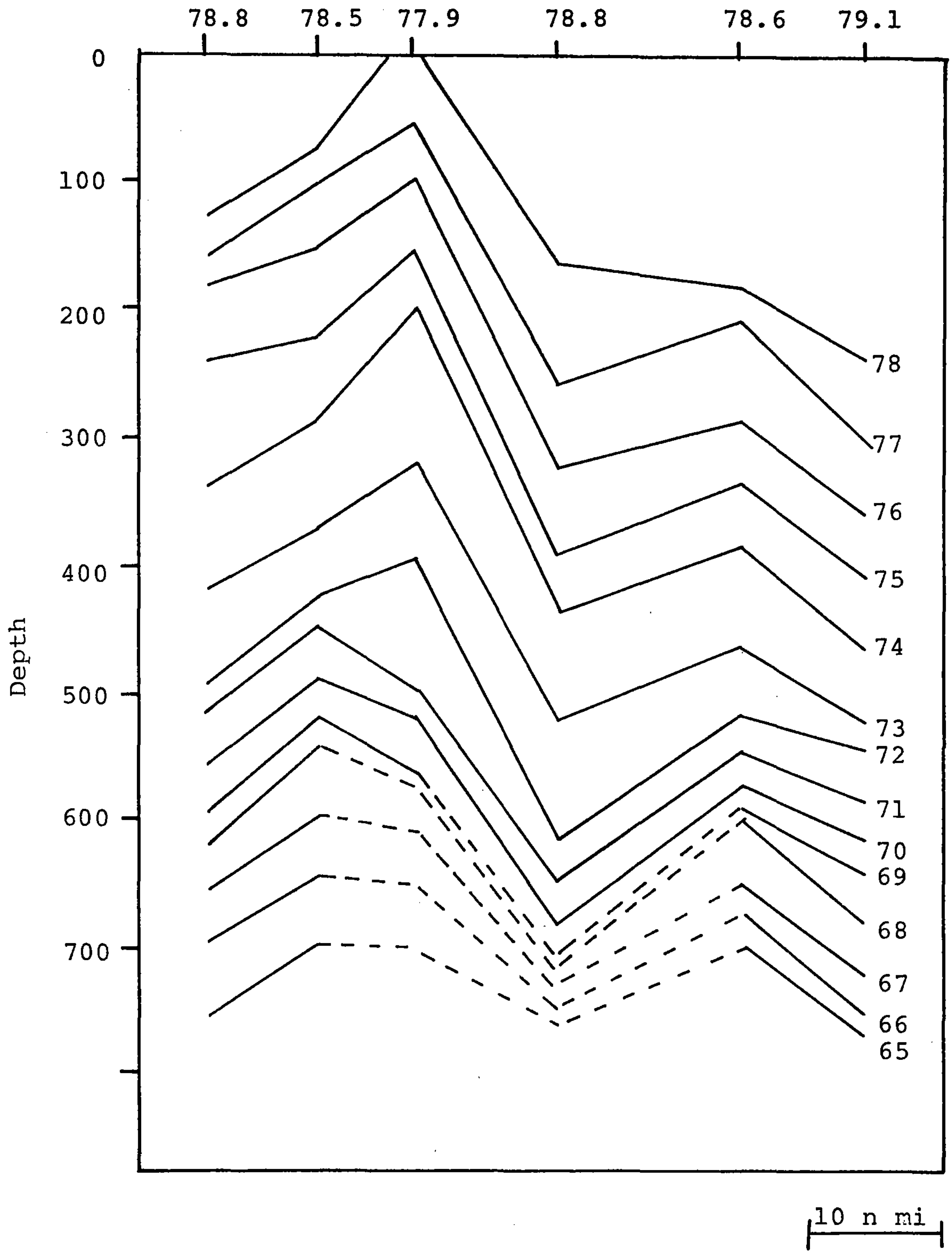


Figure 5. Bathythermograph profile across the Northwest Providence Channel. Depth in feet, temperatures in ^{o}F. Numbers at the top of the graph = surface temperature.

water to the southwest and Sargasso Sea to the northeast (see Edmonds). The first transect across the Antilles (figure 1) showed a bulge of cool water in the presumed center of the current (figure 6A). This bulge is probably a permanent feature of the system, since it was seen in a profile taken by Discovery II in 1957 (figure 6B). Further south and east (figure 3) the bulge was not present this year (figure 7A) nor was it present in 1954 when the Antilles was transected by the _Atlantis_ (figure 7B). Instead, a clear thermal front was present, separating the Sargasso Sea from the current system. These comparisons, compiled by Alan Carle, suggest some of the dynamics of the Antilles Current. In the southern latitude, when it is recently separated from the rest of the North Equatorial Current, it is warm (77°F or 25°C at the surface) and shows a deep wind-mixed layer (figure 7A & B). This deep wind-mixed layer is probably due to the long time the current spends in the trade-wind belt as it crosses the Atlantic. As the current turns toward the northwest, and travels north, it cools (surface temperature 74°F, 233°C) and the wind-mixed layer becomes more shallow (figure 6A and B). The current has by this point passed out of the region of steady trade winds, the bulge in or near the center at this point may represent a mixing effect: cooler, "northern" water from the Bahamian shelf may mix at the western edge of the current while the part of the current away from the edge retains its integrity. That the current wobbles back and forth in a motion analagous to the well-known Gulf Stream wobble can be seen in the different longitudes of the bulge in the two transects: it was centered near 75°W in 1957 and near 75°30'W in 1982.

The current velocity and volume transport of the current were studied (McKee) and the possibility of local upwelling near the Bahamian Shelf was investigated (Carle). These reports follow.

NOTE: As this report went to press, the results of a single drift bottle experiment came in. A Perrier bottle released at 23°09.5'N by 85°23.0'W (station 46, fig. 1) was found in Ft. Lauderdale, Fla., on 17 April 1982 at 0830 hr by James Edward Messer. (Mr. Messer did not give us his address so we were unable to thank him for his cooperation.) That the bottle ended up in Fort Lauderdale rather than somewhere on the west coast of Florida or even on the Yucatan Peninsula suggests that the _Westward_ was in the Loop Current, which feeds into the Gulf Stream, at the time the bottle was released.

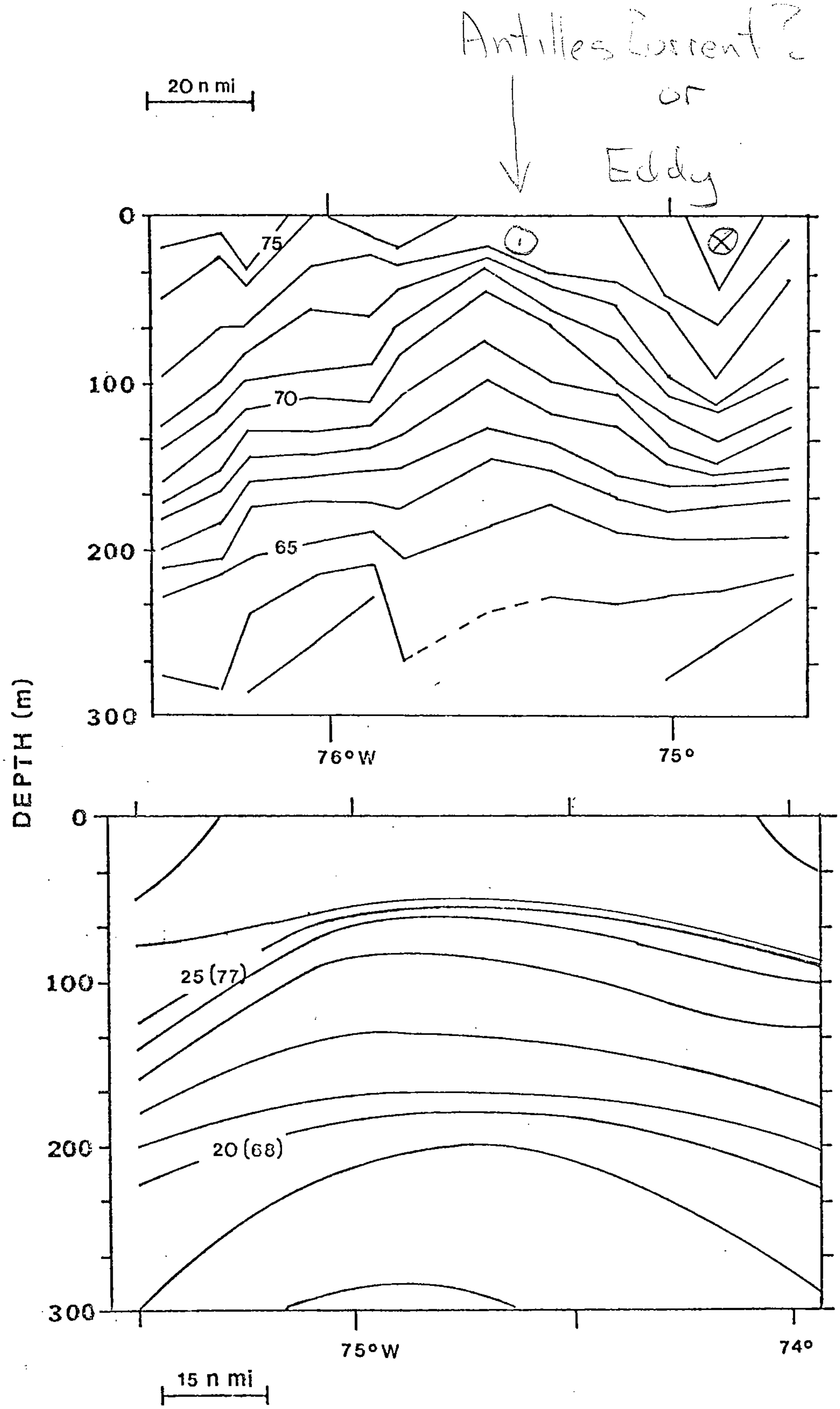


Figure 6. A. (Top). Bathythermograph profile across the Antilles Current at latitude 26° N, February 1982, R/V Westward. B. (Bottom). Bathythermograph profile across the Antilles Current at latitude 24° 30'N, October 1957, R/V Discovery II.

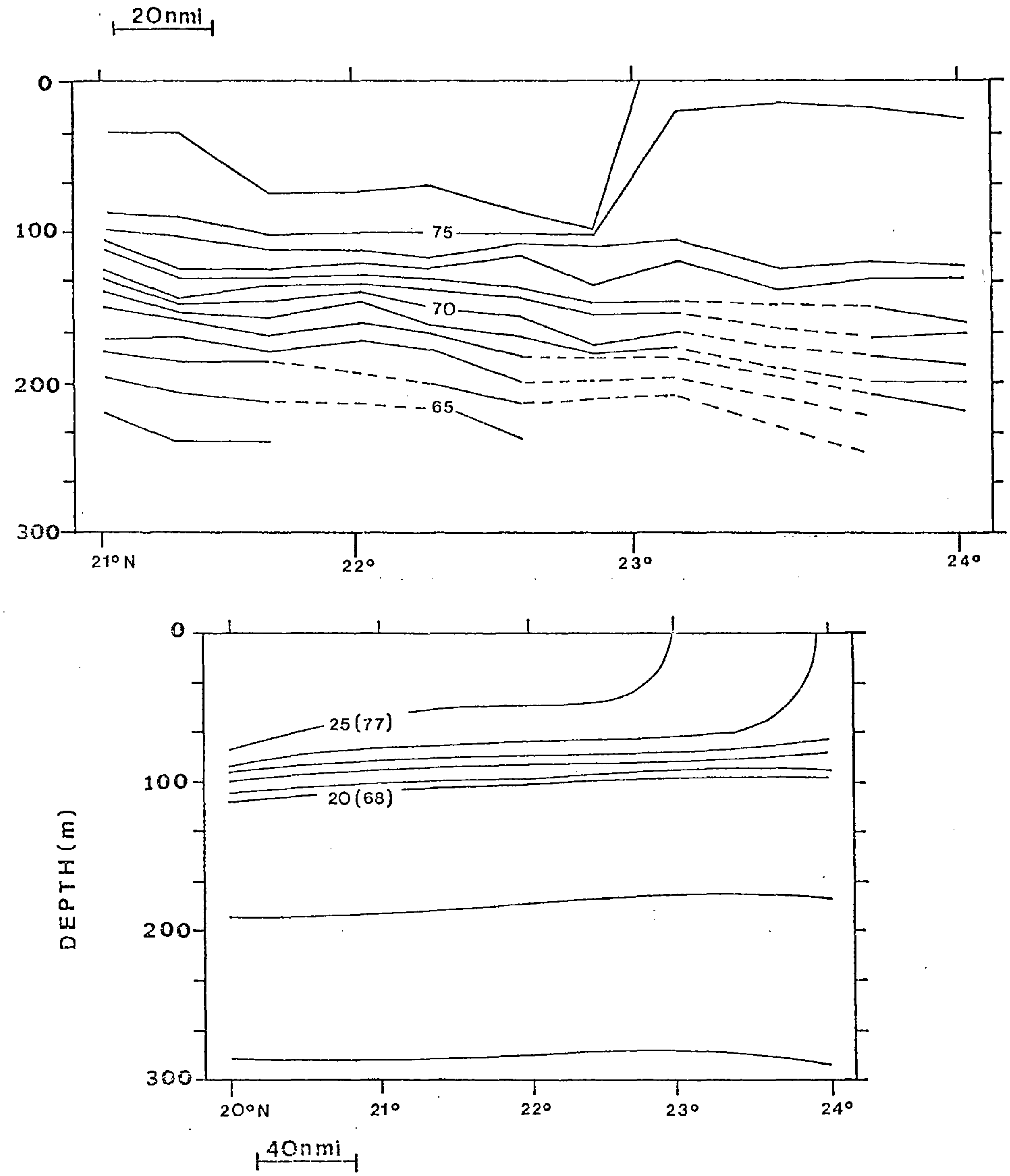


Figure 7. A. (Top). Bathythermograph profile across the Antilles Current at longitude 69° 30' W, February 1982, R/V *Westward*. B. Bathythermograph profile across the Antilles Current at longitude 66°W, winter 1954, R/V *Atlantis*.

A study of the Antilles Current - Sargasso Sea boundary

Elizabeth Edmonds

ABSTRACT

A diffuse boundary exists between the Antilles Current and the Sargasso Sea. On two transects made across the current, a total of five hydrocast stations and twenty-five bathythermograph (BT) stations were done to look for this boundary (figures 3, 6, and 7). The two BT profiles of the current showed distinct eastern and western fronts 192 km apart. The eastern front of the northernmost transect has characteristics that suggest a countercurrent or other unusual feature. A temperature/salinity diagram showed that the depth at the center of the current was approximately 290 m. The density, temperature, salinity, and phosphate profiles each suggested that at 26°N latitude the eastern boundary of the Antilles Current was between 75°25'W and 75°35'W longitude (figure 8).

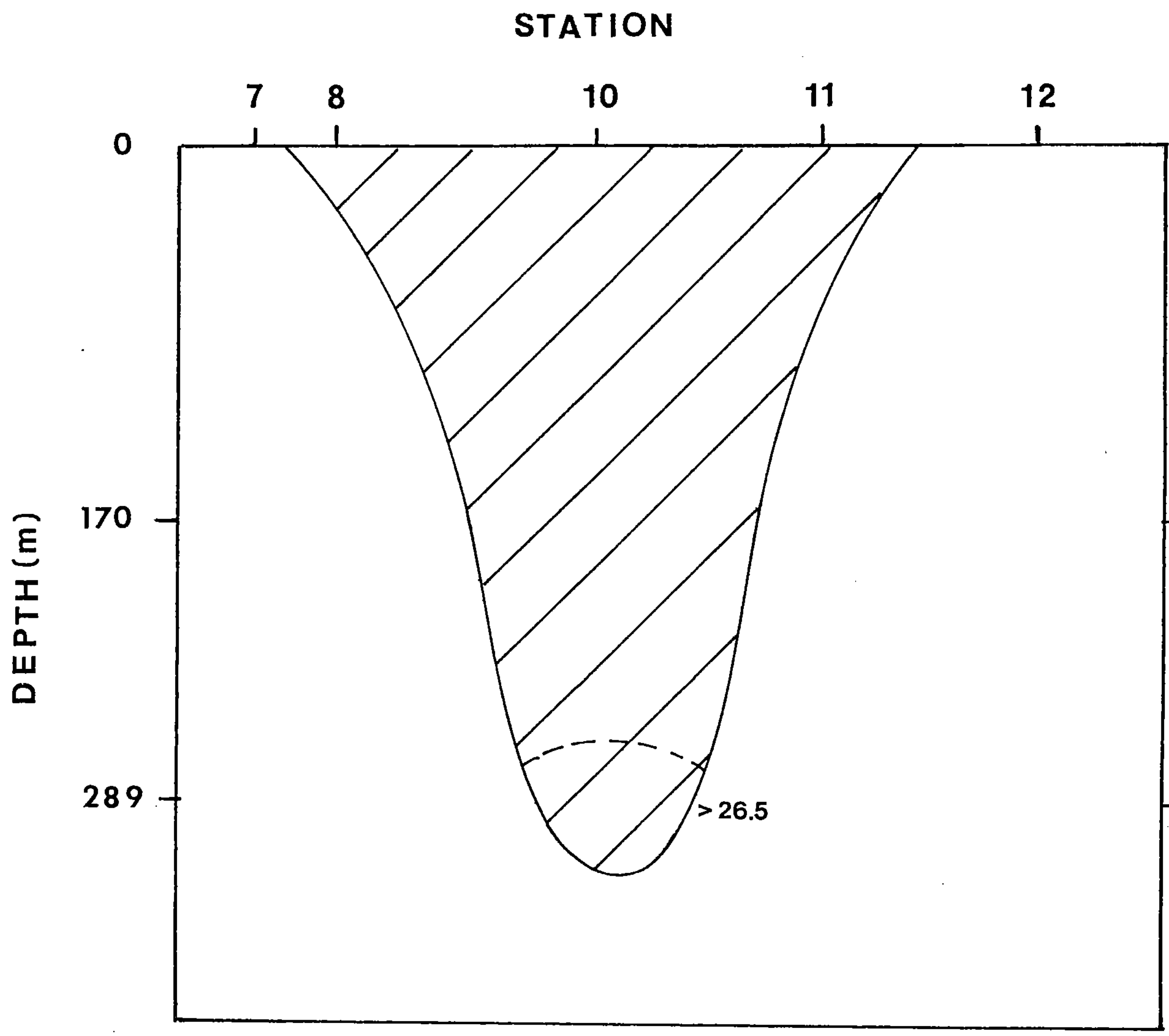


Figure 8.. Boundaries of the Antilles Current at 26° N, based on density , temperature, salinity, and phosphate profiles. Dashed curve marks the boundary of water with a σ_t greater than 26.5.

Measurements of the rate of flow and volume transport of the Antilles Current by geostrophic calculation

Dan McKee

ABSTRACT

Geostrophic calculations were used to determine the rate of flow of the Antilles Current and thus the volume transport of the current. These calculations involved the determination of a pressure gradient across a transect.

Sample collection was made along a transect that covered about 130 nautical miles and was approximately 25°40'N and 75°35'W (figure 9). The transect consisted of five hydrocasts, each containing six Nansen bottles spaced equally from 0 to 300 meters in depth. Temperature, salinity, and density calculations were done to provide data for the geostrophic calculations.

The data suggested a surface velocity of 0.72 knots and a transport volume of 8.6×10^5 m^3/sec, both of which were consistent with earlier work.

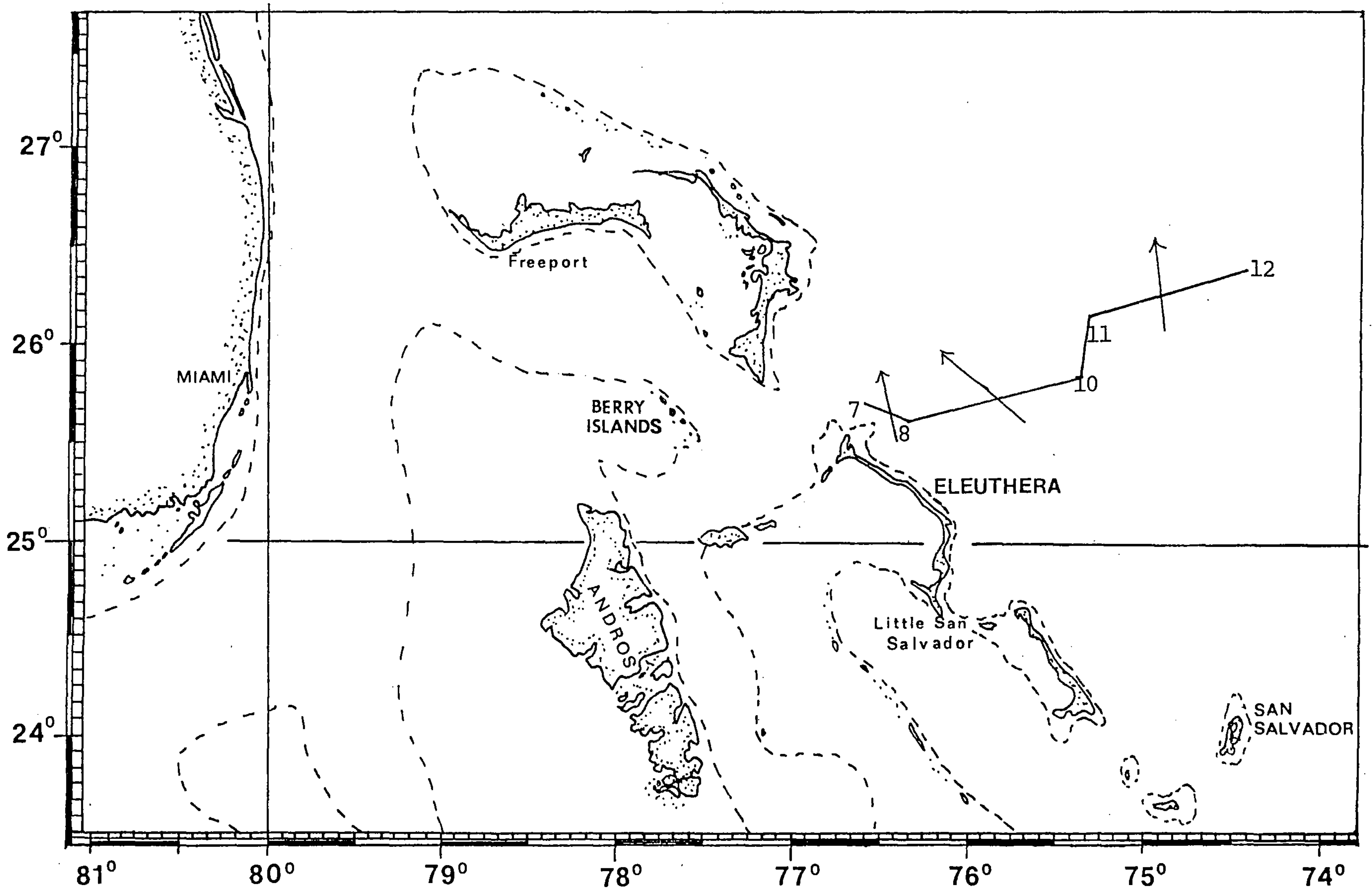


Figure 9. Hydrocast and bathythermograph transect across the Antilles Current. Numbers represent hydrostation positions. Arrows show calculated direction of flow between stations, with length of arrow proportional to intensity of flow.

An investigation of upwelling along the Bahama Banks in the region of the Antilles Current

Kenneth A. Carle

ABSTRACT

Upwelling is a process whereby cooler, more dense, less saline, and more nutrient-rich water from deeper water layers are forced up to the surface. A major benefit of such a process is that the surface water's nutrient concentration can be replenished.

The purpose of my study was to locate any areas of upwelling along the Bahama Banks region on the side bordering the Antilles Current. Two transects of the Antilles Current were made (figure 3). On transect #1, 12 BT's were performed and 5 hydrocast stations were carried out. From the hydrocasts, salinity, density, and phosphate profiles were constructed of the transect. From the BT's of transects #1 and #2, temperature profiles of the resepctive transects were constructed.

Both temperature profiles showed well developed thermoclines, thus indicative of a non-upwelled transect (figures 6 and 7). In addition, no relatively dense or nutrient-rich water was detected on the surface of transect #1, and the salinity of the transect decreased with depth. All these observations indicate there was no upwelling at the study site.

BIOLOGICAL AND OTHER OCEANOGRAPHIC STUDIES

Introduction

In nearly any study of the ocean, the type of water in the region studied will be the determining factor regarding (1) the productivity of the region, (2) the kinds of organisms that live there, and (3) the sediments that settle to the bottom there. In the studies that follow, water type was taken into consideration in various ways.

Mark Murray-Brown began with the hypothesis that water type is not as important as supposed in determining the organisms that live there, and that in fact oceanic currents distribute all plankton to all water masses in the world ocean. He did find similar diversities and compositions among the water masses sampled but found no index species of boreal waters, a finding that would have been necessary to support his hypothesis.

The effect of the Caribbean water mass on the existence of or characteristics of a phenomenon known as the chlorophyll maximum layer has not been investigated until recently. Michael Farber tested the hypothesis that this layer should exist in the Caribbean even in the winter, and he found it. Caribbean water also affected zooplankton size, showing larger organisms than were found on Navidad Bank (Underwood).

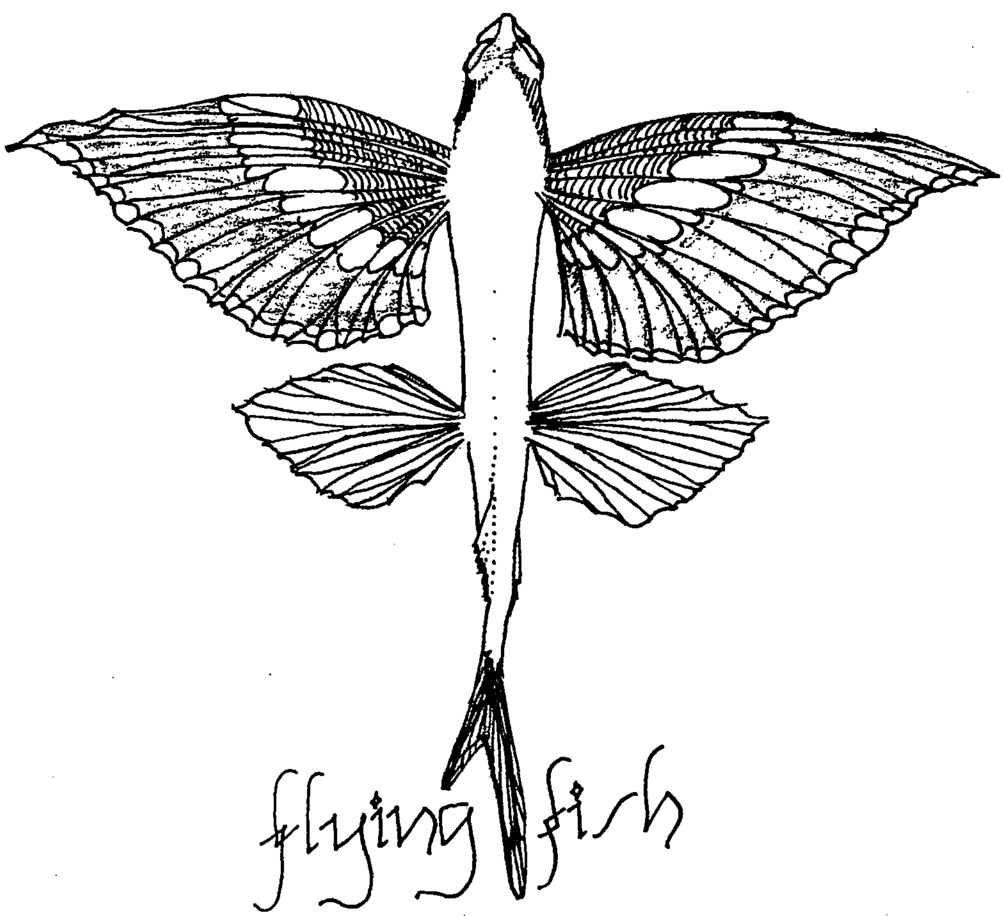
One of the intriguing puzzles of fish biology is why freshwater eels undergo an extensive migration to spawn in the Sargasso Sea. Now, even the location of the spawning ground is under some dispute, and one project was devoted to the testing of the hypothesis that eels spawn further south and east than has been supposed (Patton). The findings were suggestive enough to encourage further work.

Distribution of mesopelagic, or midwater, fish was influenced by water type: more varieties were seen in the passage between Hispaniola and Cuba than were seen in either the Antilles Current or the Caribbean Sea (Briggs). Distribution of parasites on fishes seemed to be more related to vertical than to horizontal habitat of the fish. No visible parasites were found on any of the midwater fish whereas about half of the surface fish were infected (Mansfield).

Water type may have influenced diversity of a type of shelled protozoan, the foraminifera, that ended up in sediments, and certainly water depth influenced the percentage of foraminifera found there (Buehler).

One study in this section examined the possibilities of expanding the use of photography as a scientific tool on the ship. As a result, the need for a darkroom on an oceanographic research vessel was clearly highlighted (Skoglund).

Abstracts of these project reports follow.



An investigation into the community concept of microplankton

Mark Murray-Brown

ABSTRACT

Five stations (6a, 8, 20A, 25, and 29; figure 2) were sampled for microplankton to test the idea that certain microplankton are found only in discrete water masses and are therefore indicators, or "index species," of those water masses. It is my belief that oceanic currents circulate all microplankton populations around the seas so that locating an "index species" is really a matter of technique. My aim was to identify within one region a species that was meant to be an indicator of another area and so give evidence of a homogenous ocean.

A list of genera found showed little difference between samples in the Providence Channel and Antilles Current (stations 6A and 8) and stations near Hispanolia (stations 20A, 25, and 29), although the latter showed somewhat higher diversity (table 3). The findings suggest that these waters are fairly homogeneous, but to support the idea that the world ocean is homogeneous, it would have been necessary to identify index species of boreal waters. No such index species were found.

Table 3. Microplankton identified from samples in Providence Channel, Antilles Current, and near Hispaniola on cruise W-62.

Phylum	Class	Genus	Station No. 6A	8	20A	25	29
Cyanophyta		Trichodesmium	+*	+	+	+	+
Pyrrophyta		Ceratium	+++	+++	+++	+++	+++
		Goniaulax	+	+	+	+	
		Noctiluca	++		+	+	+
		Peridinium	+	+	+	+	+
Chrysophyta	Bacillariaceae	Bacterioasteria			+	+	+
		Chaetoceros	+	+	+	+	+
		Fragilaria		+	+		
		Lauderia	++	++	+	++	+
		Navicula	+++	+++	+++	++	++
		Nitzschia			+	+	+
		Paralia	+		+	+	+
		Rhizoselenia	++	+++	++	++	
		Thalassionema			+	+	
	Mastigiophera	Silicoflagellate	+	+	+	+	+
Protozoa	Foraminifera	Globigerinoides			++	++	+
	Radiolarious	Lithomelissa		+		++	++
		Sphaerozoidea		+	+	+	+
	Tintinnids	Parundella		+	+		
		Rhabdonella		+	+	+	
		Microplankton No.	11	14	19	18	14
		Phytoplankton No.	11	10	15	14	10

*Number of +'s indicates relative abundance. + = few, ++ = moderate, +++ = abundant, no symbol = not seen.

The determination of the chlorphyll maximum layer within the Caribbean Sea

Michael Farber

ABSTRACT

Throughout the oceans, it is being found that there may be a subsurface or deep chlorophyll maximum layer (DCM). This layer, occurring as deep as 150 meters can contain up to 10 times the amount of chlorophyll that is found at the surface. This project dealt with finding a DCM in the Cayman Trench if the Caribbean Sea and in doing so, testing Venrick's hypothesis* that these maxima should occur in the southern latitudes, even in the winter. Using Nansen bottles to sample the water and a fluorometer to determine the levels of chlorophyll present, two stations were found to have very clear DCM's, and one station showed a less clear DCM (figure 10). Both occurred well below the Euphotic Zone. This phenomena was correlated to the existence of the pycnocline and possibly a "nutricline."

*Venrick, E.L., J.A. McGowan, and J.A. Mantyla. 1973, Deep maxima of photosynthetic chlorophyll in the Pacific Ocean. Fish. Bull. 71(1): 41-52.

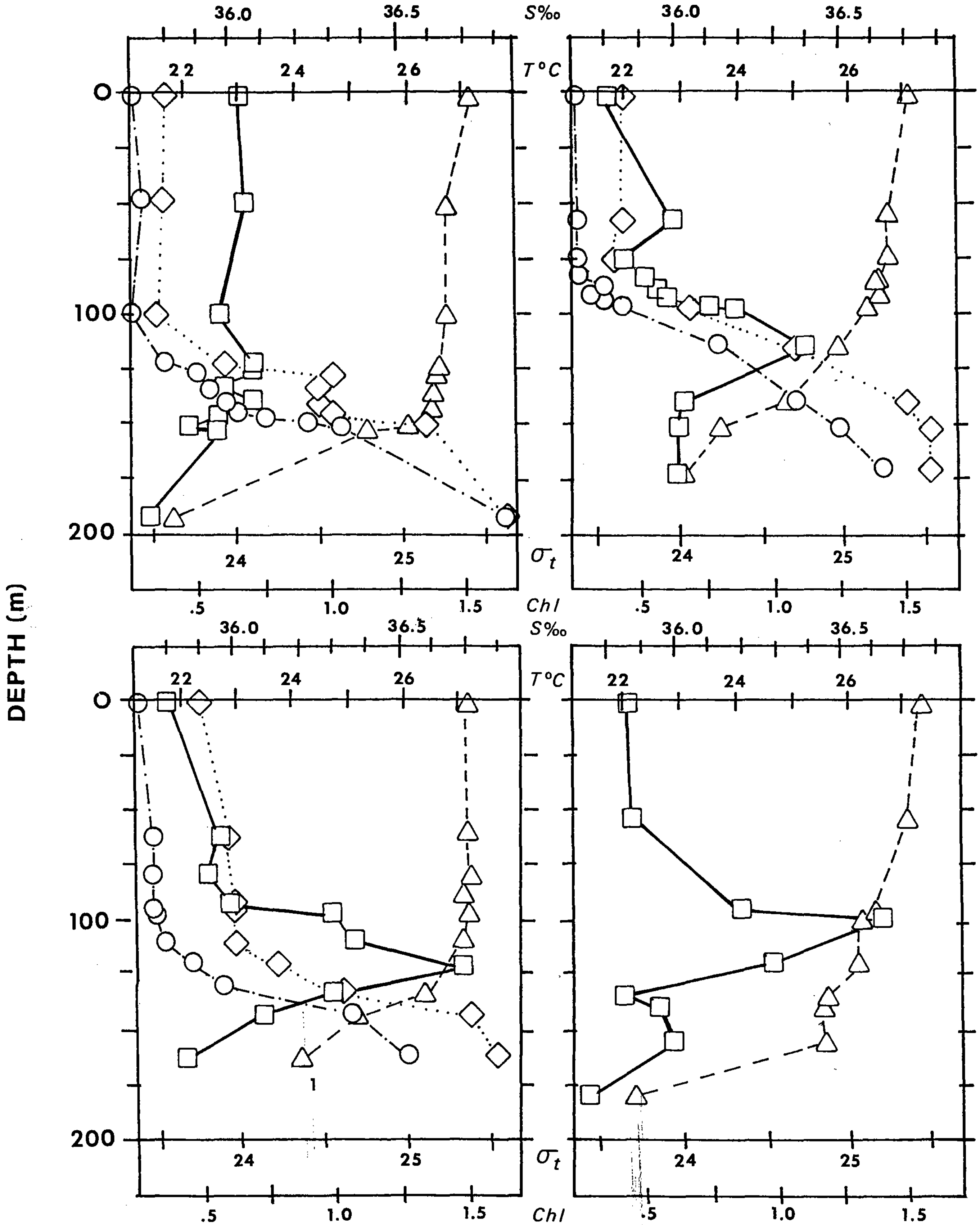


Figure 10. Hydrocast data from four stations in the Caribbean, showing a chlorophyll maximum at three stations. Squares = chlorophyll a (relative fluorescence values); triangles = temperature (°C); circles = salinity (°/oo); diamonds = density (σ_t).

Zooplankton size distribution from Navidad Bank and the Carribbean Sea

Mark Underwood

ABSTRACT

Meter net tows from Navidad Bank were compared with tows from the Caribbean Sea to study differences in the community composition between the two areas. Zooplankton were sieved onto mesh sizes of 1mm, 750µ, 505µ, and 333µ, and were analyzed for biomass by the method of volume displacement. No significant difference in total biomass was seen between the two regions, but the zooplankton from the Caribbean were noticeably larger than the zooplankton from the bank (figure 11). These data suggest that in the region sampled, the island mass effect from Cuba and Jamaica contribute nutrients to the Caribbean plankton system resulting in larger organisms whereas the nutrient - impoverished water of the Antilles Current keeps the planktonic organisms small in size.

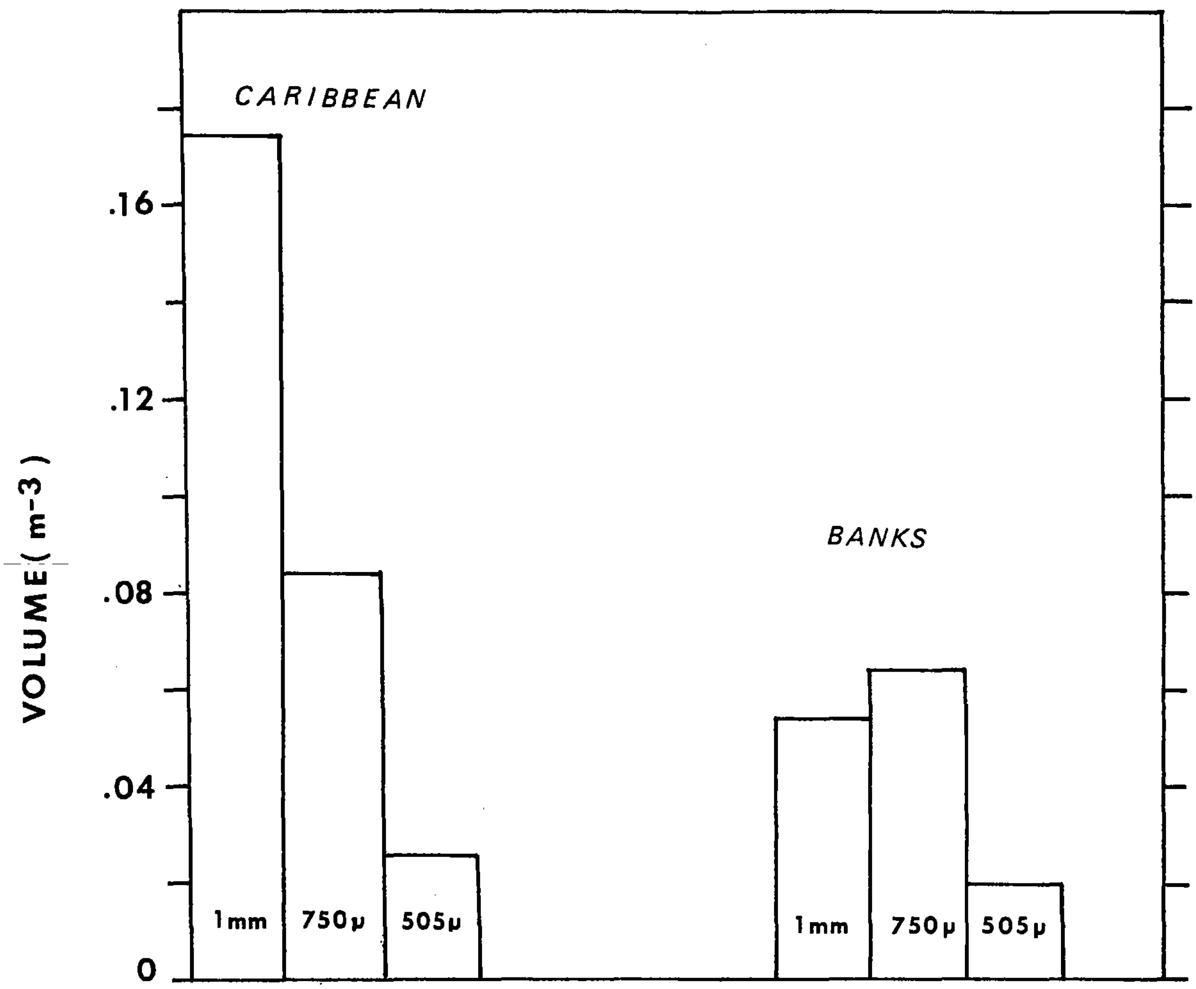


Figure 11. Zooplankton size fractions from the Caribbean Sea and Navidad Bank. Sieve size shown on bars, all zooplankton larger than that size and smaller than the next size are included in the volume (ml m^{-3}).

The possibility of a southerly breeding ground for *Anguilla rostrata*: An observational analysis

Geoffrey Patton

ABSTRACT

This investigation was undertaken to test the hypothesis that the true breeding ground of the American eel (*Anguilla rostrata*) lies in an area between 10°N and 20°N off the northeast coast of South America in the southwest corner of the North Atlantic. It is believed that if leptocephali (larval form) hatched in this area were collected in the Caribbean Sea, they would be smaller in overall length than those collected off the coast of the Bahamas because of the difference in the speeds of the currents taking the larvae to these two areas (figure 12). Oblique meter net tows were conducted at 11 stations in these two areas to sample for eel larvae at three depths. In all, 27 zooplankton samples were examined. Only one specimen of *A. rostrata* was found. Hence, the hypothesis concerning the varying lengths of the two groups of leptocephali could not be tested. However, the fact that this speciman was collected in February at a latitude of 18°38' N and was only 14.2 mm long indicates that it could have been hatched in 1982 in an area well south of the breeding grounds designated by early research in the field. Other eel larvae (72 specimens) from the study seemed to be evenly distributed throughout the two sampling areas, though the data base was too small to be conclusive. The stations off the northern coast of Hispanola yielded an abundance of eel larvae that had been observed in previous research. This phenomenon requires further attention before it can be fully explained, but currents leading into it are one possible cause.

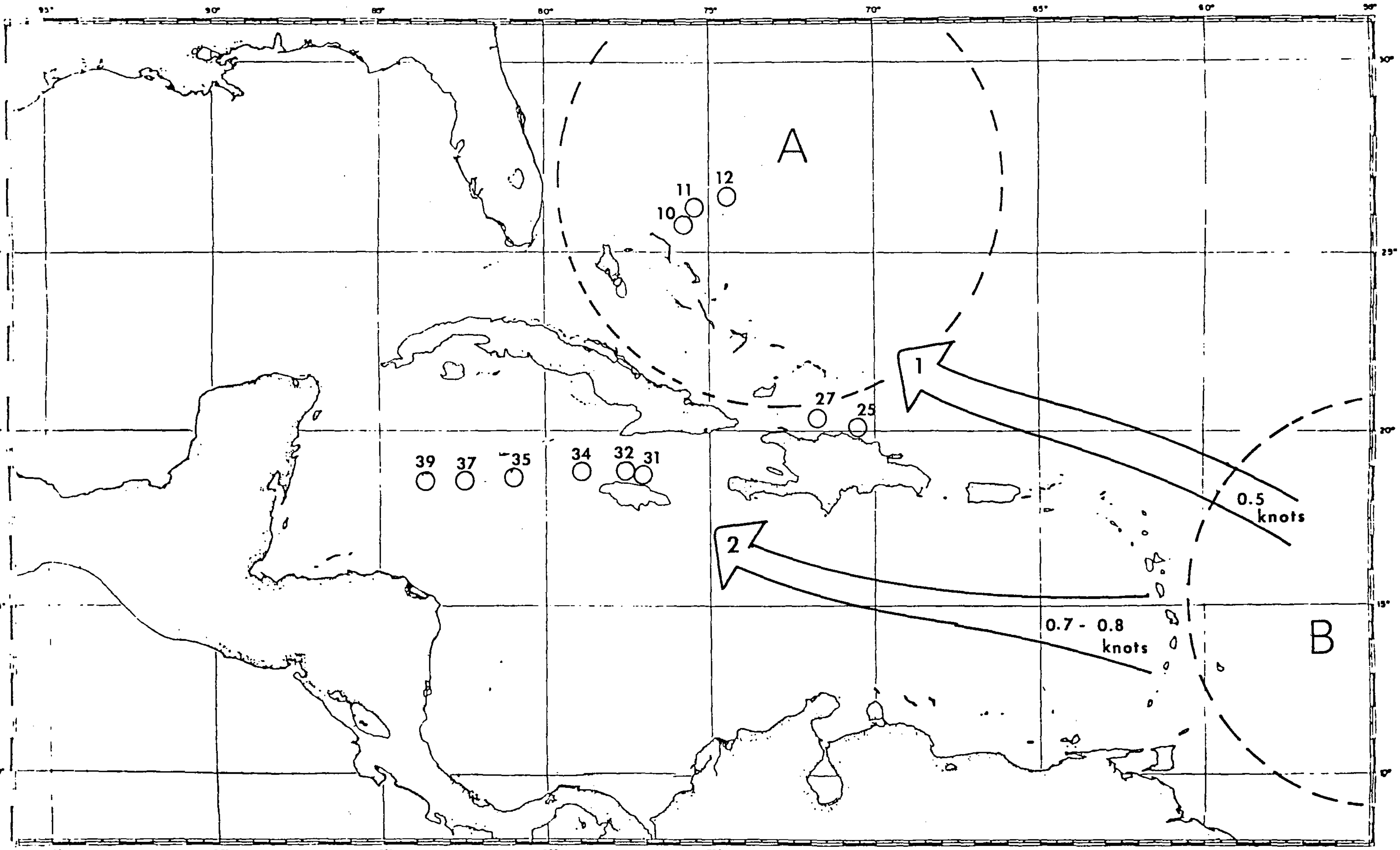


Figure 12. Two possible spawning grounds for the American eel, Anguilla rostrada, regions (A) and (B). Two possible routes (1) and (2) from region B to the sampling sites are shown, with average surface current velocities. Stations where samples were sorted for eel larvae are circles and numbered.

Mesopelagic fish in the Antilles Current, near Hispaniola, and the Caribbean Sea

Betsy Briggs

ABSTRACT

Neuston and oblique meter net tows were taken in the Antilles Current, the Caribbean Sea, and a region intermediate between the two to study the family distribution of mesopelagic fish (stations 9, 10, 12, 14, 15, 25, 27, 31, 33, 36; figure 2). These fish migrate from up to 1500 meters to the surface at night, and consequently the tows were conducted between 1730 and 0230. A total of five families were represented. Two of the families, Myctophidae and Gonostomatidae, were found in the western Antilles Current; 97% of the individuals were of the former family. The Caribbean tows also produced two families, Astronesthidae and Myctophidae. Once again the Myctophids represented a high percentage of the individuals. In contrast, the tows of the intermediate region were represented by four families: Myctophidae, Gonostomatidae, Melamphidae, and Idiacanthidae. This area has several distinctive features. First, there is an influx of both Antilles and Caribbean waters, and second, the region is bordered by land on the southern edge and shallow banks on the northern edge. I suggest that this intermediate region is a representative of non-restrictive waters whereas the Caribbean Sea and Antilles Current are both restrictive. The restrictive waters will limit the changes in fish body form occurring through mutation and evolution whereas these non-restrictive waters permit these changes to be established. The result is a greater diversity in body form, as seen by visual comparison, and in family distribution.

Table 4. Distribution of families of mesopelagic fish along the cruise track of W-62.

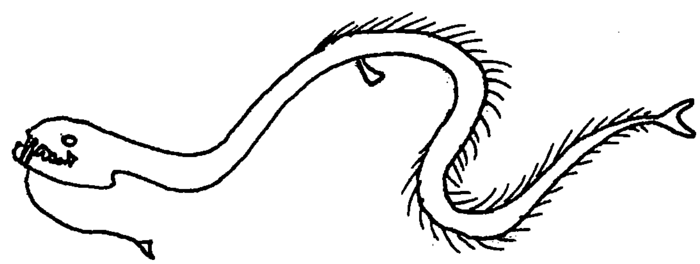
Station	Depth of tow(m)	Time	Region	No. of Specimens	Family
W62-9	Surface	1830	Western Antilles	23	Myctophidae
W62-10	0-50, oblique	0300	Eastern Antilles	0	-
W62-12	0-50, oblique	0220	Eastern Antilles	0	-
W62-14	Surface	1735	Eastern Antilles	0	-
W62-15	Surface	1735	Western Antilles	5	Myctophidae
				1	Gonostomatidae
W62-25	0-50, oblique	1830	Intermediate	1	Idiacanthidae
	50-100, oblique	1820		1	Myctophidae
				1	Gonostomatidae
	150-200, oblique	1805		6	Myctophidae
				1	Melamphidae
W62-27	0-50, oblique	0150	Intermediate	1	Myctophidae
	50-100, oblique	0145		4	Myctophidae
				1	Gonostomatidae
	150-200, oblique	0140		2	Myctophidae
W62-31	0-50, oblique	2150	Caribbean	1	Myctophidae
	50-100, oblique	2135		3	Myctophidae
	150-200, oblique	2120		0	-
W62-33	Surface	0000	Caribbean	3	Myctophidae
W62-36	Surface	0015	Caribbean	1	Myctophidae
				1	Astronesthidae

Comparison of surface and midwater fish parasites

Keith Mansfield

ABSTRACT

The parasitology of surface and midwater fish was studied on ten surface specimens collected with trawl lines and six midwater specimens collected with meter nets and neuston tows. Surface fish experienced a gill infestation frequency of 50% whereas the midwater fish experienced 0% (table 5). Although the sample size is small, these data indicate that there are basic differences between the parasitology of midwater and surface systems.



Idiacanthidae

Table 5. Comparison of parasites found on surface fish with those (not found) on midwater fish.

Fish #	Host specimen	Parasites present	Type of damage
Surface			
1	Sphyraena barracuda	none	No damage
2	S. barracuda	none	No damage
3	S. barracuda	1 dermal copepod family Pandaridae	No damage
4	Caranx fusus	1 gill isopod family Aegidae Aega sp	No damage
5	S. barracuda	none	No damage
6	S. barracuda	none	No damage
7	Coryphaena sp.	3 gill copepods 1 family Pandaridae Calagus sp 4 gill platyhelminthes digenoid	Clubbing of filament, atrophism of filament
8	Coryphaena sp.	3 gill parasites family Caligoidae	Clubbing, atropism and frayed filament
9	Coryphaena sp.	2 gill copepods family Caligoidae Caligus sp.	Clubbing and atropism of filament
10	Exocetes volitans	1 gill parasite Caligus sp.	Clubbing of filament
Midwater			
11	Gempylus serpens	none	No damage
12	Melanphaidae	none	No damage
13	Myctophidae	none	No damage
14	"	none	No damage
15	"	none	No damage
16	"	none	No damage

Comparison of sediments from the Great Bahama and Navidad Banks

Maryann Buehler

ABSTRACT

During W62, ten sediment samples were taken between Miami and Guantanamo Bay, Cuba. The samples were taken from three areas: the northern-most edge of the Great Bahama Bank, north of Andros Island, and Navidad Bank (stations 2, 4, 20, 22, 23; figure 2). The purpose of the project was to compare surface sediments of the Great Bahama Bank to surface sediments from Navidad Bank. Since both banks are tropical, support coral communities, and are at approximately the same depth, the surface sediments were expected to be similar. The study showed that the components of the sediments were indeed similar; however, the percentages of each component varied. Surface sediments from within the Great Bahama Bank also differed regarding percentages. A difference in color (due to red microfragments in one site) in these two sampling sites showed that a large area, like a bank, does not necessarily have a homogenous sediment type. The sediment composition must then depend on the physical and biological oceanographic influences in individual regions.

Samples from all these regions were poorly sorted. Each contained algal and coral fragments, foraminiferal tests, microgastropod shells and fragments, and coralline algae fragments. Samples from the second and third sites contained a high percentage of algal fragments and fragments of branching coral covered with an unidentified red algae. Percentage of sediment consisting of foramimifera was higher in shallow than in deep water. Analysis of the foraminifera yielded no conclusions about the distribution of families; however, the ratio of families to the total number of organisms may show a higher biological diversity on Navidad Bank than in the Bahamas.

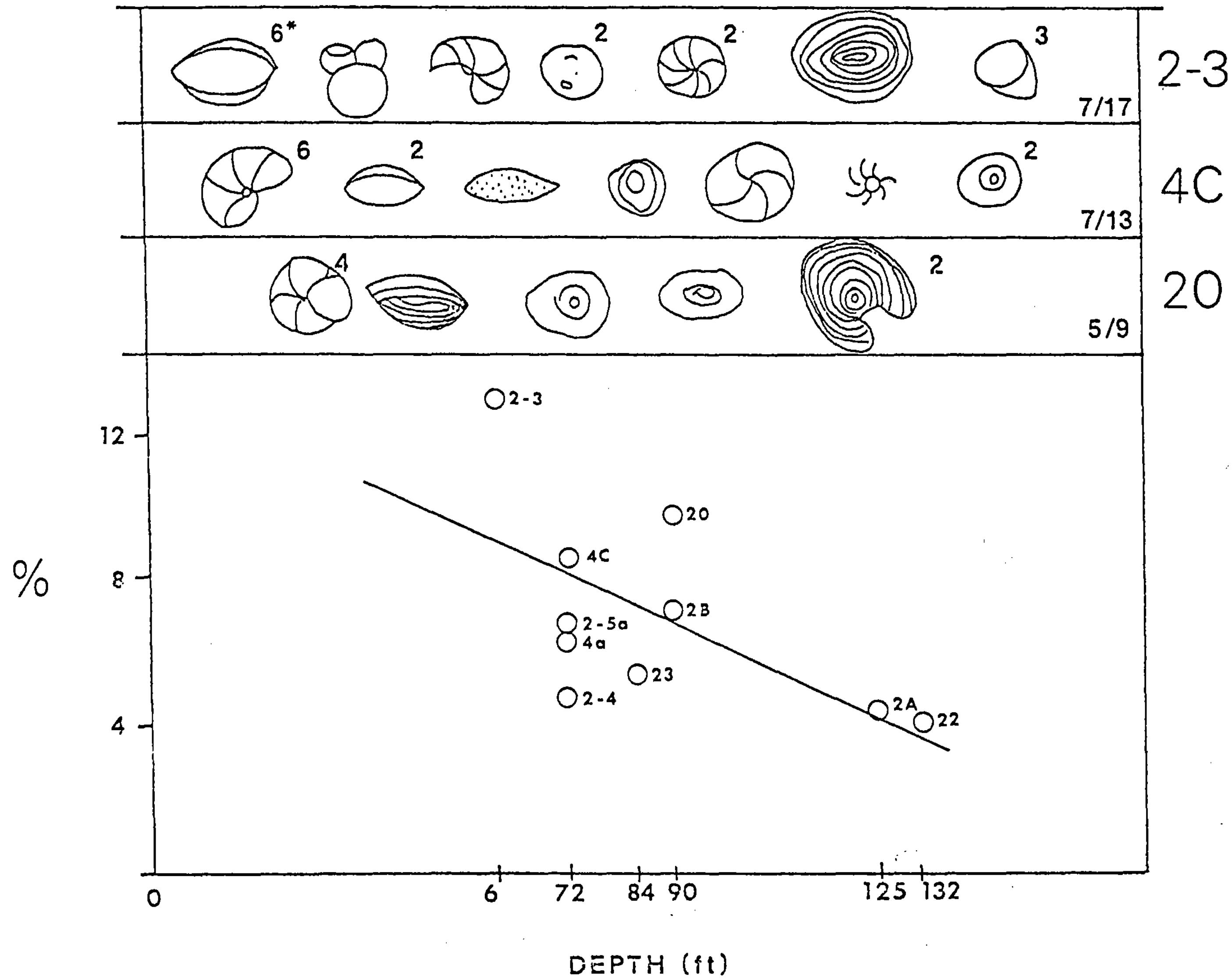


Figure 13. Percentage of foraminifera in sediment samples presented as a function of depth of sample. Numbers near circles = station numbers. Illustrations show representative foraminiferal families with number of specimens. Fractions show the ratio of families to the total number of foraminifera.

An investigation into, and an evaluation of, the use of photography aboard the R/V Westward.

Robert Skoglund

ABSTRACT

The ability to record and store data has always played a key pivotal role in the success or failure of primary research. Traditionally with living organisms, the methods employed have been to capture and preserve the organism, or merely observe the organism, if capture and preservation are out of the question. However, the invention of the camera and the advances made in recent years to simplify the photographic process while simultaneously improving the quality of the picture resolution, has made photography available as a tool of research to all levels of the scientific community.

This project was designed to document the present use of photography as a tool of science aboard the R/V Westward, and to investigate what further uses are possible aboard the R/V Westward. The project consists of two phases. The major thrust of the first phase was to document the process of 35 mm photography while it was used to establish a catalogue of the whales seen on the Navidad Banks. During the second, Westward's compatibility with a new photographic technique known as silhouette photography was tested. A primary goal was to determine the success and usefulness of silhouette photography within the limitations of the Westward

Both segments of the study point out the fact that there is much room for improvement in the photographic realm aboard the Westward. As a result of the study it was recommended that not only should a dark room of some kind be added to the Westward, but that the proposed second ship should have space for a legitimate dark room.

LONG-TERM STUDIES

Currently three long-term distribution studies are bein conducted under the auspice of SEA staff and associates. (1) Marine mammal and pelagic bird studies are supervised by Timothy Rumage III, who was a Visiting Scientist on this cruise; (2) neuston studies for pelagic tar and Sargassum weed distribution are coordinated by SEA staff; and (3) the distribution of the phyllosoma larvae of spiny lobsters is being studied by Mary Farmer, Staff Scientist.

In each of these areas individual research projects were conducted on W-62. Intensive work was done on Navidad Bank, one of the calving grounds of the humpback whale. A behaviorial study suggested the possibility that male humpbacks are putting on fitness displays for the females on the bank (Schembre and Pritchard), and an evaluation of food supply for the humpbacks demonstrated that not enough zooplankton calories were present for the whales to eat during their stay on the banks (Douglas, Jenkins, and Rosenthal). An overview of the work on the banks is given in Appendix VI (Rumage).

Other marine mammal work included an investigation into why so few dolphins were seen in the Antilles Current and Caribbean Sea (Carter), and Visiting Scientist, Amelia Giordano, observed the distribution and behavior of those dolphin species seen in the Yucatan and Florida Straits.

Species distribution of pelagic birds was somewhat different this year than it has been in previous years in the same region. Also, the usual mammal-bird association seen in Northern waters was noticeably absent on Navidad Bank, supporting the findings that the humpback whales were not feeding in these waters (O'Neil and Jacobs).

Pelagic tar was collected in nearly every neuston tow done, and its apparent age suggested that its distribution was associated with tanker routes (MacFarlane). Organisms growing on pelagic tar were similar to organisms growing on Sargassum weed, a natural substance, and drifting plastic, another petroleum product. It was suggested that tar and plastic may not be as harmful to the organisms living at the air-sea interface as has been previously supposed (Maybank).

If all the spiny lobster larvae collected in the Caribbean Sea represent larvae that eventually pass through the Yucatan Channel, then we can calculate that 76 billion (or 7.6×10^{10}) larvae pass through this Channel every month (calculations done by R. Bouchard). This number may seem outrageous at first, but examination of mortality figures and adult population figures for Florida are expected to show that the number is reasonable. Bouchard also showed that larvae captured in the Caribbean could conceivable have originated in South America. It was also shown that phyllosomes seem to migrate vertically, more so as they get older and as they approach Florida (O'Sullivan).

These studies have made fruitful contributions to our long-term research. The abstracts follow.

Distribution and behavior analysis of _Megaptera novaeangliae_ on Navidad Bank

Drew Schembre and Lisa Pritchard

ABSTRACT

The purpose of our study was to observe the distribution and behavior of humpback whales (_Megapters novaeangliae_) on Navidad Bank. Methods included two days of observations along approximately one hundred miles in four transects. A total of 210 blows, 108 behaviors (including breaching, lobtailing, fluking and flipper-slapping) and 33 mother/calf pairs (dyads), were observed and plotted on a chart of the bank over _Westward's_ cruise track (figure 14). Population densities and behavior frequencies were examined in relation to depth, time of day, and dyad location. There was evidence of greater population densities in shallow (5 fathom) water and of diurnal periodicity in behavioral activity. Most (75%) of the behaviors were observed within 13% of the total area scanned. These activities took place within one-half to one mile radius of observed dyads, supporting the possibility that a modified "lek" mating ground exists on Navidad Bank. In a lek system characteristic behaviors are exhibited by several members of one sex for the purpose of being selected by the opposite sex. The behaviors observed on Navidad Bank may therefore be fitness displays. Further studies are needed to establish conclusively whether this interpretation best explains the migration of male humpbacks to the calving grounds and, if so, which segment of the population participates in this migration.

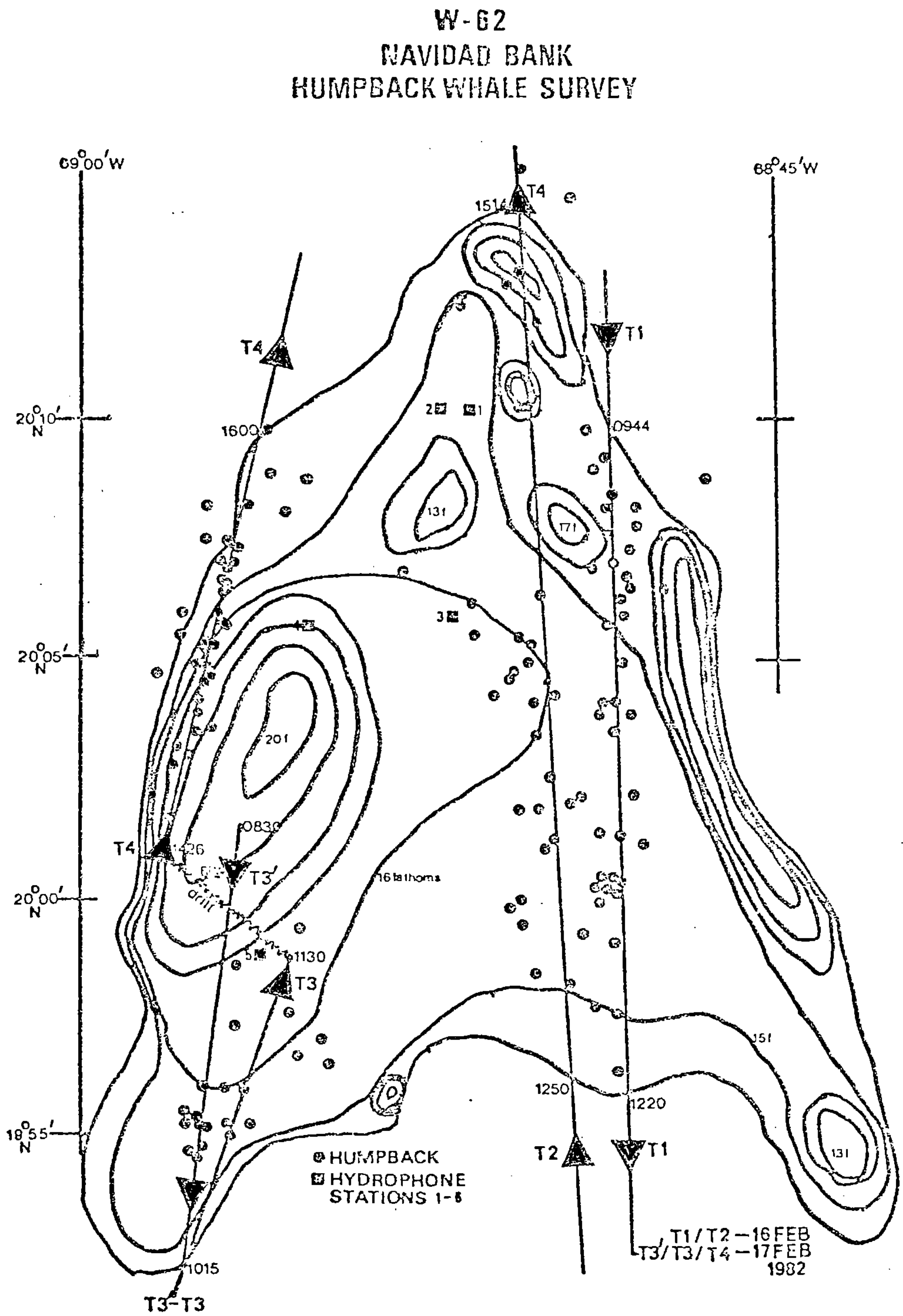


Figure 14. Westward's track over Navidad Bank and whale sightings (circles) on the bank.

Food availability for the humpback whale (Megaptera novaengliae) on the Navidad Banks of the Bahamas

Christina Douglas, David Jenkins, and Randi Rosenthal

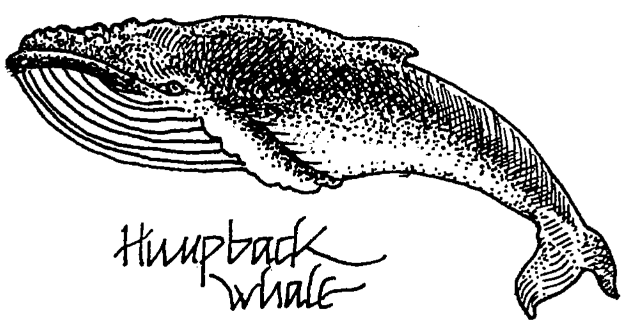
ABSTRACT

It is a matter of debate in the scientific community whether the humpback whale, Megaptera novaengliae, feeds durings its migratory period. This project demonstrates that insufficient quantities of food are available to the whales on the Navidad Bank of the Bahamas. Meter net tows were utilized to capture organisms and then the number of organisms per unit volume was determined. In addition, the organisms captured were identified. The quantity and type of food available in productive northern waters was compared to the Navidad Bank. Food on Navidad Bank was about 3,000 times less plentiful than in the Arctic and the individual organisms were smaller (table 6). The volume of Navidad Bank water a whale would have to filter, therefore, is about a million times greater than the volume of Arctic water necessary to take in the daily caloric requirement. It was concluded that the migratory humpbacks sustain their caloric requirements by metabolizing their accumulated lipid layer.

Table 6. Summary of zooplankton characteristics, as potential whale food, on Navidad Bank compared to Arctic waters.

Characteristic	Navidad Bank	Arctic
Total number of organisms/m^3	23	63,000
Average size of crustaceans (mm)	2	15
Calculated number of organisms/8000 calories*	42,634,800	101,300
Calculated volume (m^3) of water containing 8000 calories-worth of organisms	1,853,700	1.61

*Daily caloric requirement for one average humpback whale.



Distribution of dolphins in the Caribbean Sea

Christopher Carter

ABSTRACT

During the first two legs of W-62 very few dolphins were seen and so an investigation was undertaken as to why the expected large number of dolphins were not seen. Data from seven previous Westward cruises combined with those from W-62 (figure 15) showed that most sightings were in or near water 40 fathoms deep or less. This preference for shallow water may have been due to food distribution, and it may be that so few dolphins are seen on the Westward because she spends most of her sea time in deep ocean water.

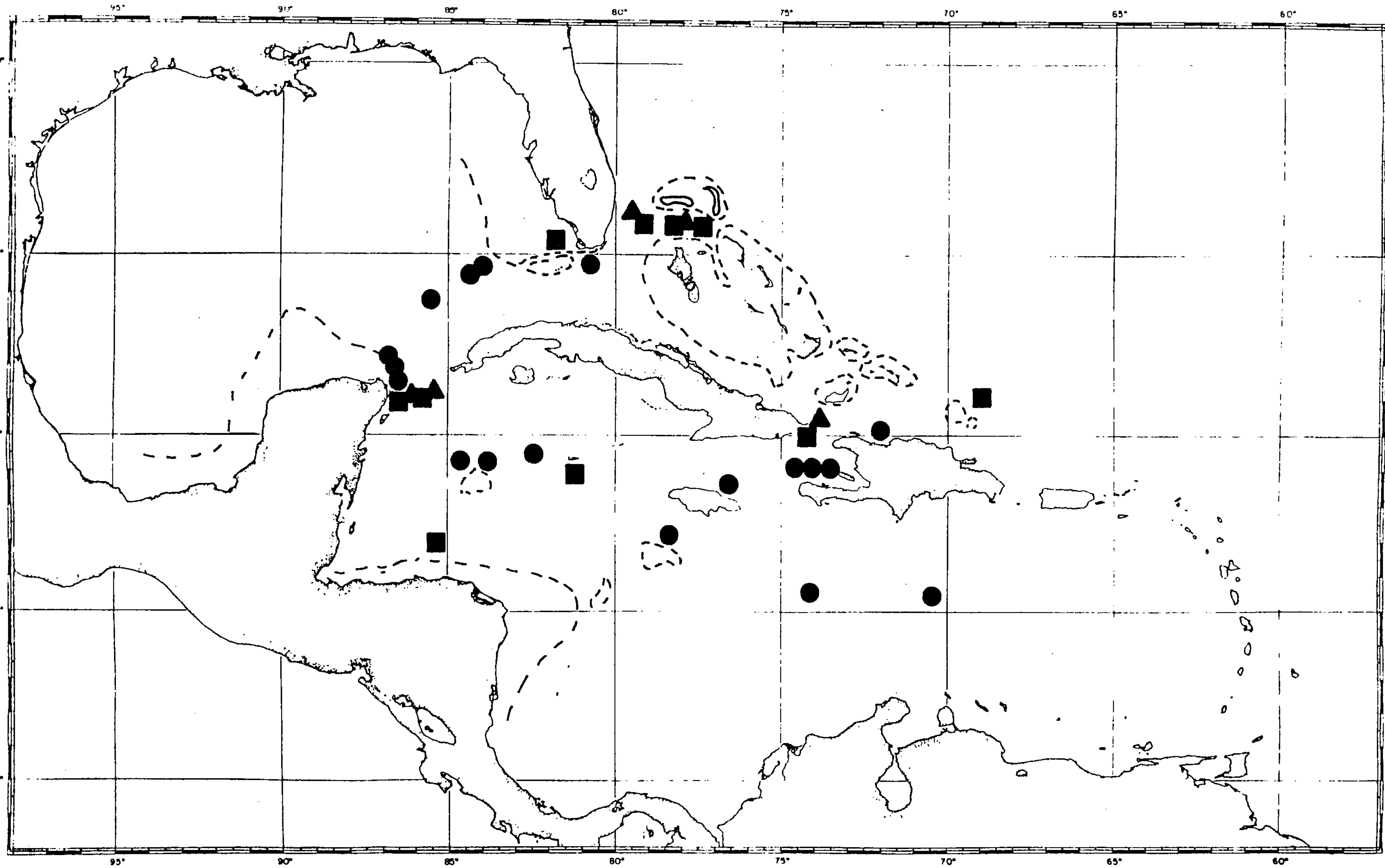


Figure 15. Dolphin sightings in the Bahamas and Caribbean from the R/V Westward over the past four years. Squares = February - March. Circles = November - January. Triangles = W-62 sightings. Dashed line = 40 fathoms depth.

Odonocete cetacean observations and distribution

Amelia Giordano, Visiting Scientist

During leg 3 of R/V Westward cruise W-62, daily observations were made to study the possible relationship between sun position and orientation of dolphin schools. Observations were done four times daily, one hour at a time, for 10 days in the Yucatan Channel and Florida Straits.

Three species were identified in three separate sightings (table 7). Considering the total number of observation hours (40), the number of sightings was not impressive. However, the qualitative information collected concerning habitat and behavior was interesting.

Tursiops truncatus was seen between the Yucatan Peninsula and Cozumel Island (figure 16), supporting the coastal distribution of the species. The school followed an east-to-west course; the time was 1500 hr. This behavior corresponds to the hypothesis that orientation (of Delphinus delphis) is west-to-east or east-to-west in relation to the sun's position (Pilleri and Knuckey, 1968). A single observation is obviously not conclusive, but should be recorded and kept in mind for future research.

Delphinus delphis and Stenella plagiodon were observed in more characteristically pelagic waters. Sightings in both cases were in the proximity of escarpments and banks, Arrowsmith bank for D. delphis and the Pinar del Rio for S. plagiodon.

If data from previous R/V Westward cruises are plotted on the chart with data from W-62, two major zones of sightings are clear (figure 16). In the western zone, characterized by D. delphis, the observations are generally localized on the Campeche Escarpment. In the eastern zone, observations are localized on the Florida Escarpment except for T. truncatus, which was sighted in shallower waters near Dry Tortugas and Florida.

The consistency of observations suggests that the animals are regularly present in their respective zones, probably because of favorable ecological conditions. Are such zones to be considered "territories"? If "territory" is used in a less strict sense for Cetaceans than for terrestrial animals or reef fishes, then we can hypothesize that the western zone does represent a territory for *D. delphis*. In the eastern zone more data on the identification of species is needed. At the moment it is only possible to speculate that the zone might represent a territory for *Grampus griseus*.

Future research should concentrate on collection of data in these two zones to test these hypotheses.

Pilleri, G., and J. Knuckey. 1968. The distribution, navigation and orientation by the sun of *Delphinus delphis* L. in the western Mediterranean. Separatum Experientia 24(394):394-396.

Table 7. Dolphin sightings in the Yucatan Channel and Florida Straits.

Date	Time	Position		Species	Remarks
8 Mar 82	1515	20°30'N	86°55'W	*Tursiops truncatus*	School of about 45 animals, swimming E-W, at least one young individual present.
11 Mar 82	0530	20°46'N	86°15'W	*Delphinus delphis*	About 15 animals.
13 Mar 82	0515	23°26'N	85°18'W	*Stenella plagiodon*	About 30 animals, swimming close to ship for 45 minutes. At least two young individuals present.

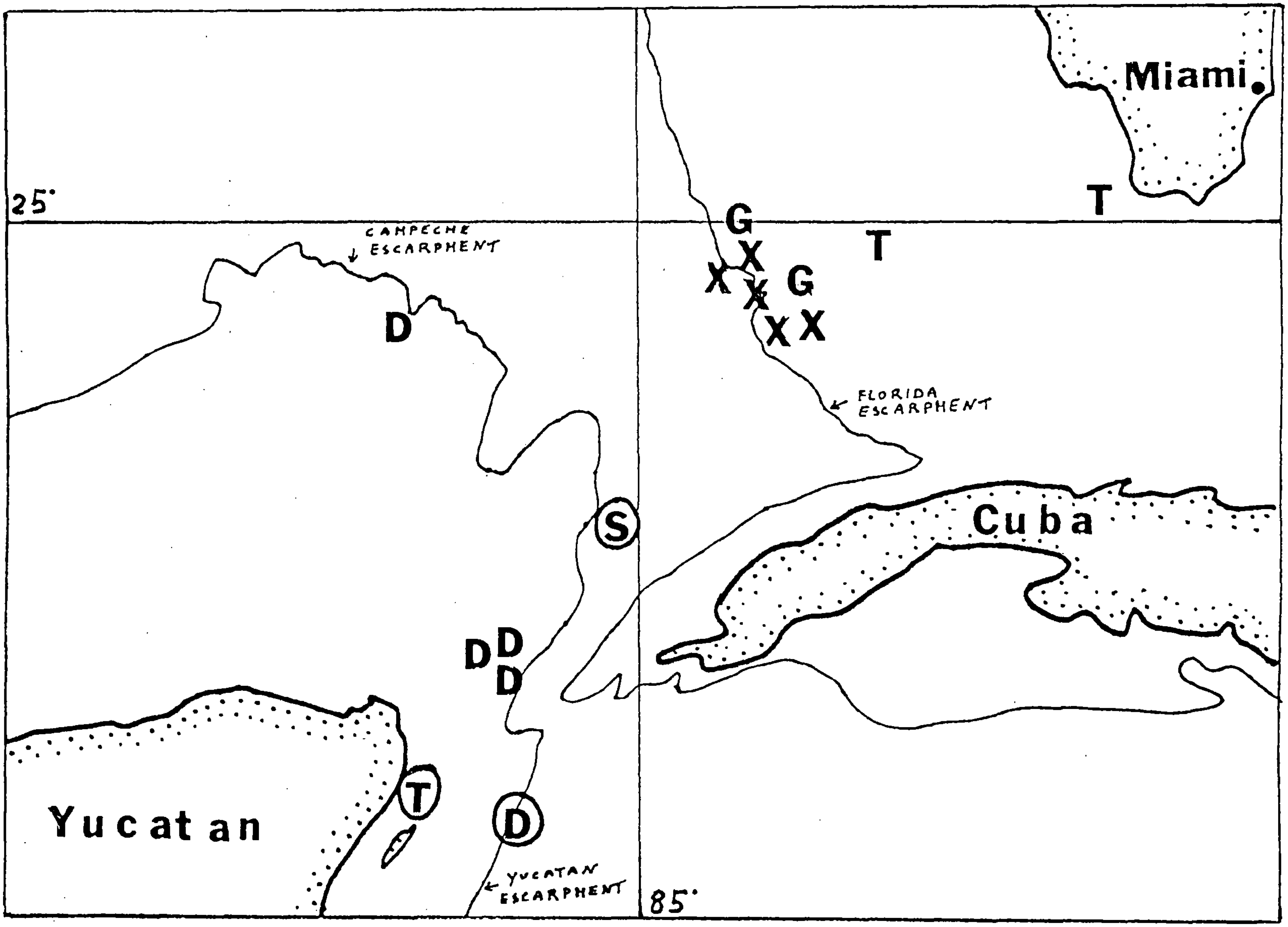


FIGURE 16 : Odontocets Cetaceans distribution in the Yucatan Channel and Florida Straits.

(T)(D)(S) respectively: T. truncatus, D. delphis, S. plagiodon, sighted during W62.

T D G respectively: T. truncatus, D. delphis, G. griseus, sighted on previous R/V Westward cruises.

X : unidentified dolphin.

The relationship of productivity to seabird distribution in the Bahamas and the Caribbean

Judy O'Neil and Barbara Jacobs

ABSTRACT

Pelagic birds rarely come to land except at breeding season and hence very little is known about their lives at sea. One factor limiting our knowledge is an inadequate number of the repeated observations needed to establish a pattern of distribution and seasonal variation. This study was undertaken to provide data for Westward's ongoing collection of bird sightings and to study the association between plankton biomass and number of birds seen.

Most sightings (92%) were within 60 miles of land (figure 17) which may be due to increased productivity near land where river runoff and upwelling are possible. Flocks of terns, gulls, and boobies were seen off Hispaniola where plankton biomass was 0.083 ml m^{-3}. Off Jamaica frigatebirds and flocks of terns and boobies were associated with a biomass of 0.059 ml m^{-3}. By contrast, only 6 birds were seen along a 300-mile transit of the Antilles Current, where biomass averaged 0.019 ml m^{-3}. Only 3 birds were seen on Navidad Bank where more than 100 whales were counted. Although mammal and bird sightings are usually associated, evidence gathered on this cruise suggested the whales on Navidad were not feeding and that in fact the plankton biomass there was too low for them to feed efficiently (Jenkins, Rosenthal, Douglas, this report).

On previous cruises more petrels, shearwaters, and white-tailed tropic birds have been seen than on this cruise whereas this year more boobies and frigatebirds were seen than usual. Species distribution may therefore vary from year to year.

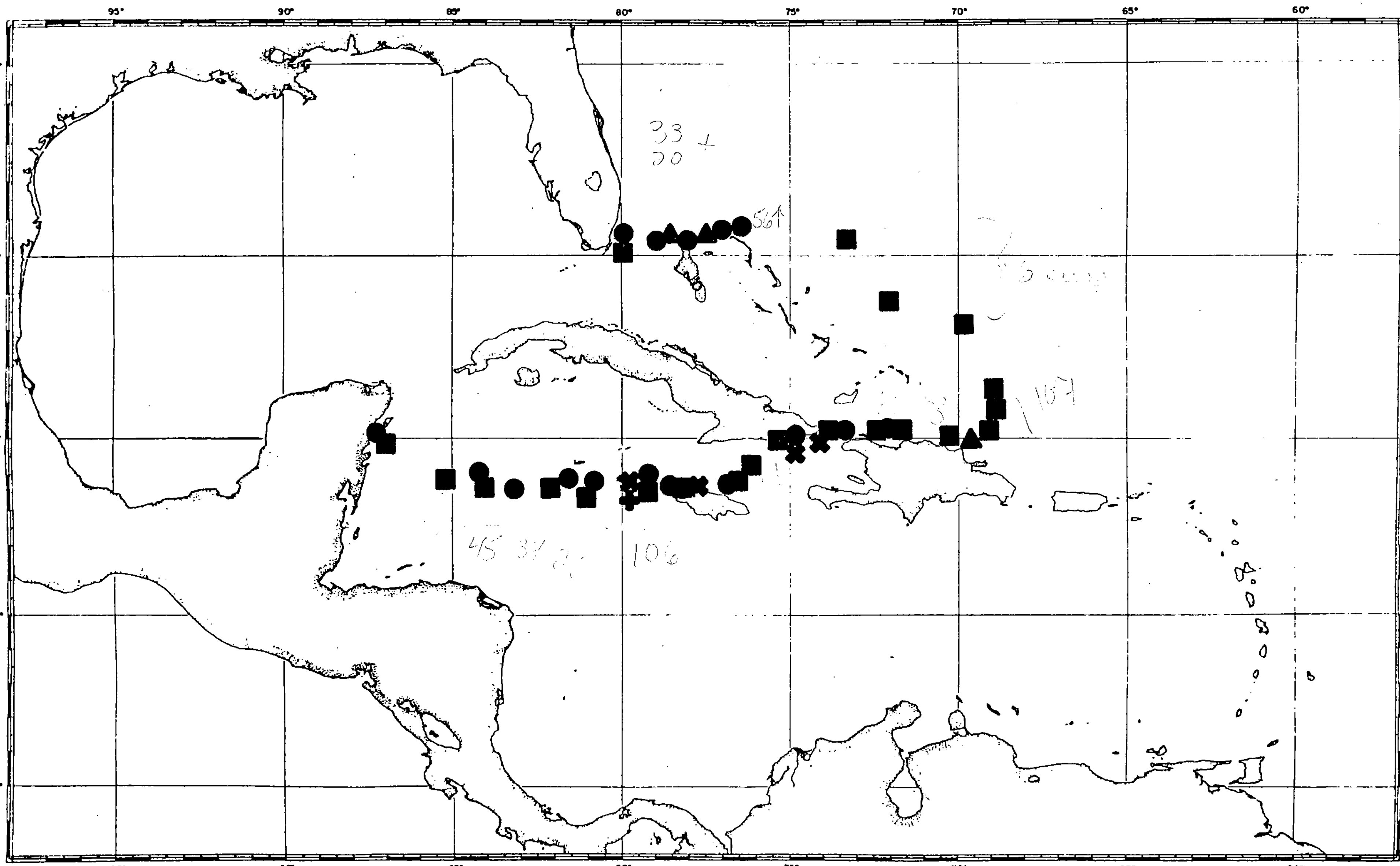


Figure 17. Pelagic bird sightings on cruise W-62. Symbols represent sighting but do not indicate frequency. Circle = Charadriformes; square = Pelicaniformes; triangle = Procellariformes; X = Falconiformes; cross = Ciconiformes.

Distribution of pelagic tar in the South Sargasso Sea, Northern Caribbean, and in the region windward of the Bahamas

Ingrid MacFarlane

ABSTRACT

The distribution and concentration of pelagic tar along W-62's cruise track, with samplings from the South Sargasso Sea, the Northern Caribbean, and the region just windward of the Bahamas, was studied as part of a long-term Westward study. Fifteen neuston tows were deployed for an average tow time of 30 minutes and at an average tow speed of 2 knots. Tar was recovered in all but two tows (figure 18). All stages of decomposition seem to have been recovered. Attempting to plot the data against current charts proved inconclusive because of other factors such as atmospheric conditions and underwater geologic forces affecting the tar distribution as well as currents. Distribution and concentration relative to oil tanker routes and the North Equatorial Current, however, was significant. Oldest, least concentrated tar was found furthest from the tanker routes and had traveled longest in the North Equatorial Current. Youngest tar was found closer to the oil lanes and had traveled less time in the North Equatorial Current. Increased use of these oil lanes suggests that the recent increases in amounts of pelagic tar recovered may be associated with tanker traffic.

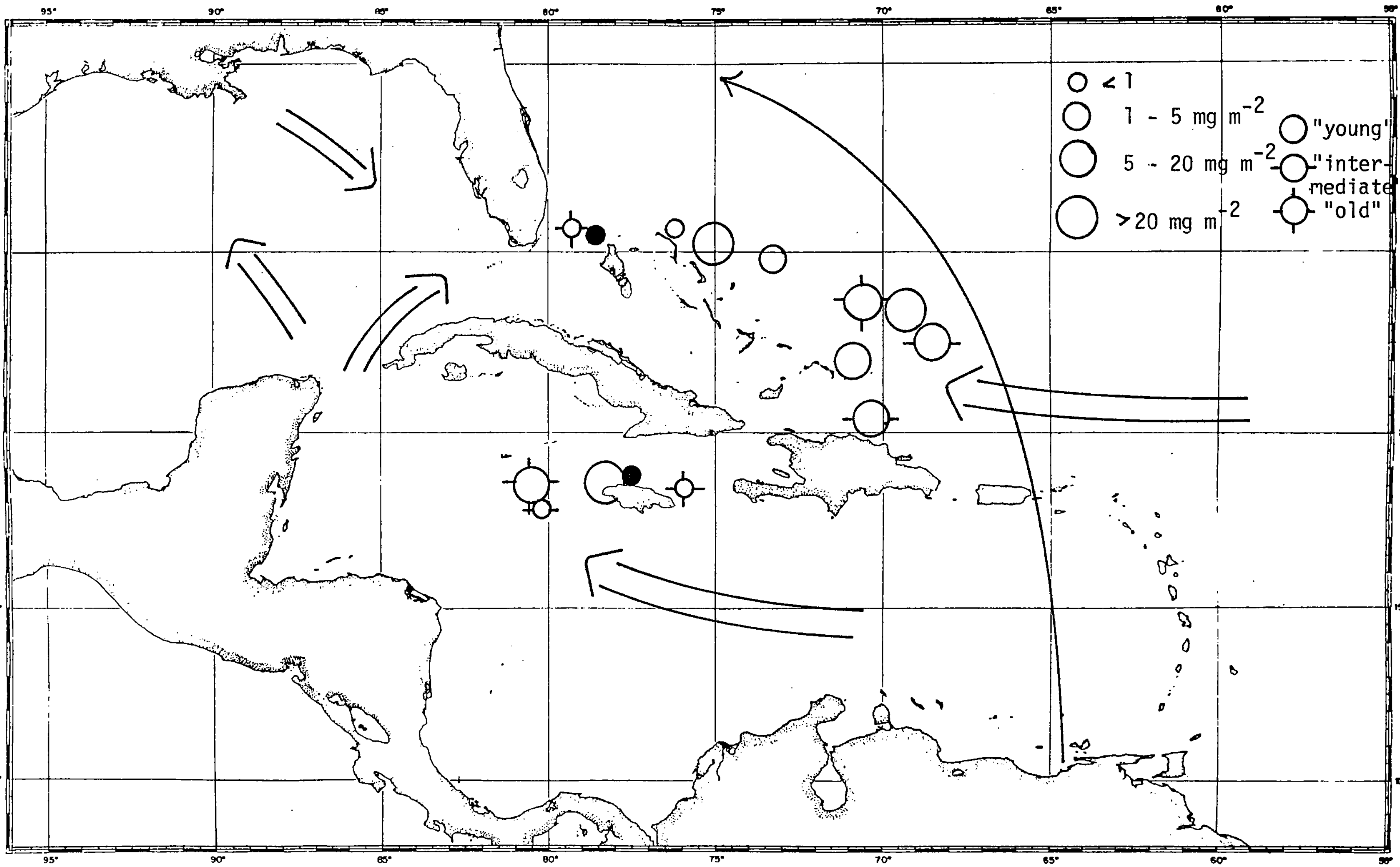


Figure 18. Distribution of pelagic tar relative to water movements and tanker routes in the region of the Caribbean and the Bahamas. Size of circle in proportion to tar concentration, as shown in key. Filled circle = no detectable tar. Bars on circles represent relative age of tar as shown in key. Single arrow = general transport of oil on tankers. Double arrows = significant currents in the region.

An investigation of pelagic tar and Sargassum communities, or, the case of the plastic knot

Jane H. P. Maybank

ABSTRACT

A study of epifaunal communities was done on tarballs and Sargassum weed collected by dip net and in neuston tows. Knots from plastic garbage bags appeared unexpectedly in some samples and these knows provided a substrate that was Sargassum-like in form and tar-like in origin. Five pelagic tarballs ranging from 1 m^{-3} to 3 m^{-3}, five clumps of Sargassum of similar size, and 2 plastic knots were analyzed. Of the 9 phyla found, 7 were on Sargassum, 5 on plastic, and 4 on tar (table 7). Together, plastic and tar carried as many varieties of organisms as the natural weed, contradicting the assumption that these substances are harmful to the pelagic environment in this form.

Table 7. Flora and fauna found on various substrates floating at the surface.

		Number of species		
Phylum	Class	Sargassum weed	Plastic	Tar
Coelenterata	Hydrozoa	3	5	-
	Anthozoa	1	1	-
Annelida	Polychaeta	2	2	2
Arthropoda	Crustacea	1	-	1
Mollusca	Gastropoda	1	-	1
Ectoprocta	Cheilostomata	1	-	-
Chordata	Ascidacea	1	-	1
	-	-	1	-
Chlorophyta	-	-	1	-

Transport of the larvae of the spiny lobster, *Panulirus argus*.

Randal S. Bouchard

ABSTRACT

The phyllosoma larvae of the spiny lobster, *Panulirus argus* (Latreille) were collected from plankton hauls made in the Antilles Current and the Caribbean Sea. A total of 29 larvae were collected in 7 of 15 meter net tows, and these were identified and staged according to Lewis* (1951). Knowing the approximate age of the larvae and the average current velocities of the region, it was possible to calculate the maximum possible distance traveled since hatching and the probable path of migration (table 8). It was concluded that the northeast coast of South America is the most likely source of the Florida spiny lobster population (figure 19).

*Lewis, J.B. 1951. The phyllosoma larvae of the spiny lobster, *Panulirus argus*. Bull. Mar. Sci. Gulf Carib. 1(2):89-103.

Table 8. Calculation of maximum distance traveled by phyllosoma larvae in the Antilles Current and the Caribbean Sea, and their approximate stage upon reaching Florida waters.

	Antilles Current	Caribbean Sea
Number of larvae captured	3	24
Mean stage	8.7	7.8
Approximate mean age (days)	200	178
Maximum distance traveled on currents shown in figure 20 (naut. mi.)	2,400	2,990
Distance remaining to Florida on currents shown in figure 20 (naut. mi.)	330	750
Approximate stage upon reaching Florida waters	10+	10

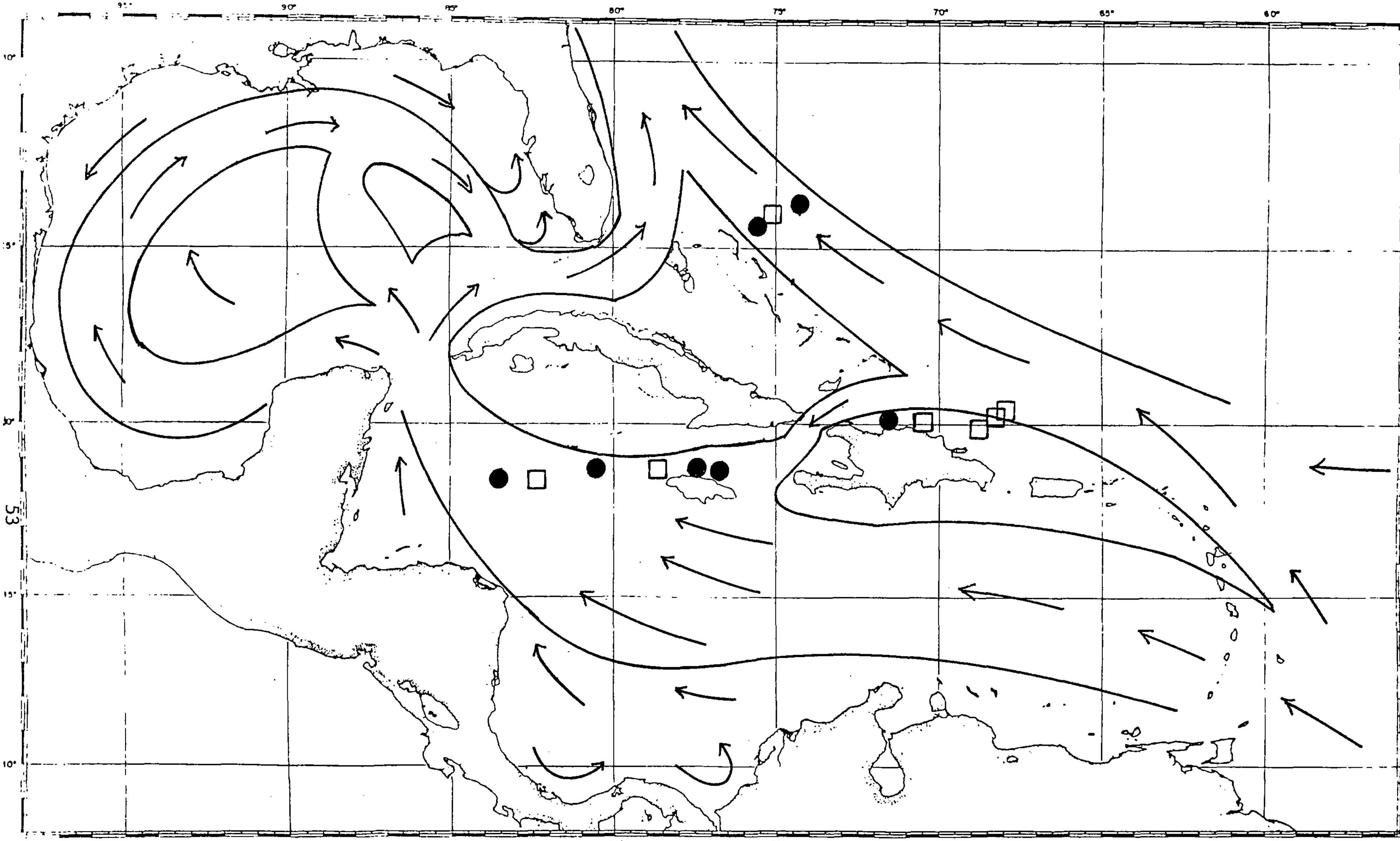


Figure 19. Current outlines showing probable paths of transport of phyllosoma larvae captured on W-62. Squares = stations where phyllosomes were found. Circles = no phyllosomes.

A study of the vertical migration of the phyllosoma larvae of the spiny lobster in the Caribbean and the Antilles Current

Rebecca Bennett O'Sullivan

ABSTRACT

A study of the vertical migration of the spiny lobster phyllosoma larvae was conducted in the Caribbean and the Antilles Current. Oblique meter net tows done at three depths simultaneously, and neuston tows from the surface, were sorted and 29 spiny lobster larvae were collected. In response to many physical and environmental factors the phyllosoma larvae migrate to deeper waters as they age. Correspondingly the depth distribution of the larvae is indicative of specific stages of development. Mean stages increased with the depths in this study (table 9) and also the depth at which most larvae were found increased as we approached the Yucatan Straits.

The evidence supports a model in which larvae are transported across the Caribbean to the Yucatan Straits by prevailing currents. During this horizontal transport, larvae seek deeper waters as they age so that on the average spiny lobster larvae are found in deeper water in the western Caribbean than in the eastern Caribbean.

Surface waters only were sampled in the Antilles Current, and these larvae were older than the ones in the Caribbean, being more nearly ready to settle out of the water column.

Table 9. Summary of data on phyllosoma larvae (Genus Panulirus) collected on W-62.

Station	Depth			No. of Larvae	Mean Stage
	Upper (0-50 m)	Mid (50-100 m)	Lower (150-200 m)		
W62-10, night	8,8	-	-	2	8
W62-12, night	10	-	-	1	10
W62-27, night	8, Scyllaridae	-	11	3	9.5
W62-31, night	8,8,8,8,7	11,8,8	10,8,7	11	8.3
W62-32, day	6,7,9	10,9,6,4	8, Palinurus	9	6.6
W62-35, day	-	9,8	8	3	8.3
W62-39, day	-	-	11	1	11

Hourly Surface Temperatures

Surface water temperature was taken hourly throughout the cruise. Examination of a plot of surface temperature versus time (figure 20), with reference to the cruise trace in figure 1, highlights the main trends. (1) From Miami to the Antilles Current surface temperature slowly decreased to a minimum on the 8th of February, when we passed out of the Providence Channel. (2) Thereafter, temperature rose unsteadily until the 19th of February, when the ship was just north of Hispaniola. (3) Temperatures from Hispaniola to Cozumel were nearly constant. (4) After passing through the Yucatan Straits, temperature dropped, then rose as we approached Miami. These trends are best explained in terms of the general gyre circulation of the North Atlantic and of uneven latitudinal heating of the earth's surface.

As was discussed in the section on the Antilles Current, the *Westward* sampled some major features of the North Atlantic gyre system on this cruise. A secondary feature of some current systems is a counter-current that runs adjacent to the main current but is smaller, usually cooler (if the main current is moving poleward), and sometimes slower than the main current. The abrupt decrease in temperature on the 8th of February, as the *Westward* moved from the Providence Channel into the Antilles Current may have marked just such a counter-current.

The increase in temperature seen as the ship traveled south within the Antilles Current was a direct result of uneven heating of the earth: water gets warmer as one moves south toward the equator. Likewise, the nearly constant temperature experienced across the Caribbean reflects the cruise track, which was virtually at the same latitude throughout that section.

Finally, the decrease in temperature seen on 14 and 15 March shows when the *Westward* slipped out of the gyre circulation system into the local Gulf of Mexico waters. These waters were still cool from winter temperatures. The last increase approaching Miami was due to our re-entry into the gyre system and the main current known as the Gulf Stream.

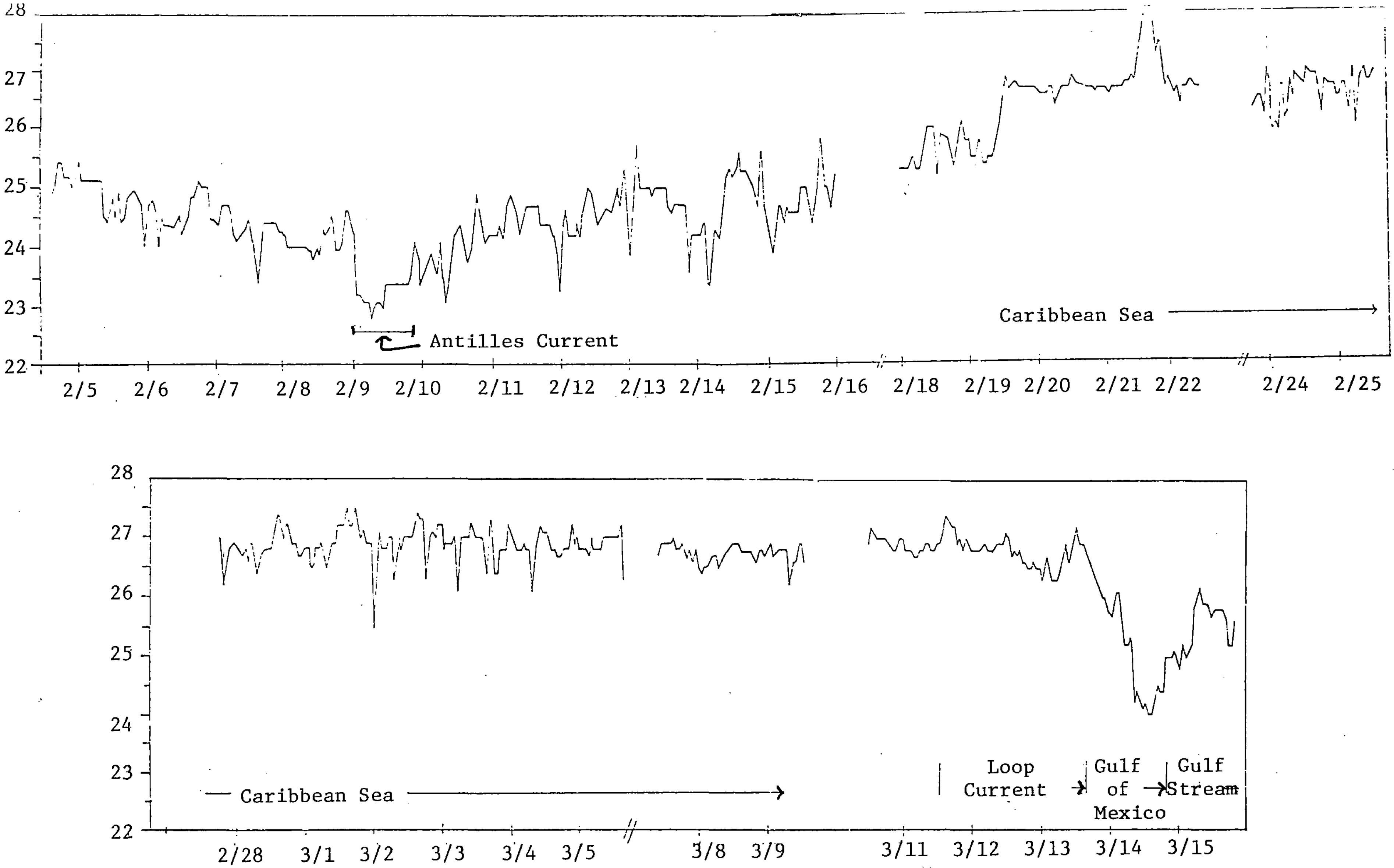


Figure 20. Surface temperatures throughout cruise W-66. Temperatures are given on the vertical scale, in °C.

Cooperative Ship Weather Observation Program (NOAA)

The R/V Westward is certified to gather weather observations for the U.S. National Oceanic and Atmospheric Administration in cooperation with an international weather program. The data, collected at 0600 and 1200 GMT, form part of a global grid for forecasting and satellite surface-truth purposes.

On W-62, 63 complete sets of meteorological data were collected, of which 75% were successfully transmitted by radio to Coast Guard receiving stations on shore.

APPENDICES

APPENDIX I. W-62 Station Summary

Station No.	Date	Time	Latitude (N)	Longitude (W)	Work done
W62-1	04 Feb 82	1640	25°57'	79°53'	Bathythermograph (BT), hydrocast
W62-2	05 Feb 82	1220	25°59'	79°12'	Sediment scoop
W62-3	05 Feb 82	1750	26°27'	78°55'	Neuston tow
W62-4	06 Feb 82	0920	25°46'	78°12'	Sediment scoop
W62-5	06 Feb 82	1245	25°57'	78°08'	Neuston tow
W62-6A	07 Feb 82	1155	25°49'	77°30'	Phytoplankton tow
W62-6B	07 Feb 82	1400	25°45'	77°29'	Neuston tow
W62-7	08 Feb 82	0540	25°37'	76°31'	Hydrocast
W62-8	08 Feb 82	1100	25°36'	76°18'	Hydrocast
W62-9	08 Feb 82	1830	25°43'	76°09'	Neuston tow
W62-10	08 Feb 82	2250	25°51'	75°52'	Hydrocast, meter net
W62-11	09 Feb 82	1120	26°08'	75°19'	Hydrocast, meter net
W62-12	09 Feb 82	2300	26°24'	74°36'	Hydrocast, oblique tow
W62-13	11 Feb 82	1100	25°13'	72°43'	Test of opening/closing system
W62-14	11 Feb 82	1830	24°53'	72°40'	Neuston tow
W62-15	12 Feb 82	1803	22°54'	72°02'	Neuston tow
W62-16	13 Feb 82	1335	24°03'	70°56'	Neuston tow
W62-17	14 Feb 82	1225	22°41'	69°48'	Neuston tow
W62-18	14 Feb 82	1520	23°22'	69°41'	Neuston tow
W62-19	16 Feb 82	1004	19°46'	68°27'	Meter net tow
W62-20	16 Feb 82	1750	20°14'	68°48'	Meter net tow
W62-21	17 Feb 82	0755	20°06'	68°55'	Meter net tow
W62-22	17 Feb 82	0900	19°59'	68°55'	Sediment scoop
W62-23	17 Feb 82	1550	20°12'	68°51'	Sediment scoop

APPENDIX I. (continued)

Station No.	Date	Time	Latitude (N)	Longitude (W)	Work done
W62-24	17 Feb 82	1730	20°10'	68°52'	Meter net tow
W62-25	18 Feb 82	1410	20°04'	70°17'	Hydrocast, simultaneous tow
W62-26	19 Feb 82	1135	20°09'	70°33'	Neuston tow
W62-27	19 Feb 82	2349	20°20'	71°41'	Hydrocast, simultaneous tow
W62-28	20 Feb 82	0800	20°12'	71°42'	Phytoplankton tow
W62-29	21 Feb 82	0631	20°00'	73°38'	Phytoplankton tow; hydrophone listen
W62-30	24 Feb 82	1243	18°43'	76°13'	Neuston tow
W62-31	24 Feb 82	1955	18°38'	76°52'	Phytoplankton tow; meter net tow; hydrocast
W62-32	25 Feb 82	0903	18°43'	77°23'	Oblique tow
W62-33	28 Feb 82	0000	18°32'	78°14'	Neuston tow
W62-34	28 Feb 82	1100	18°48'	78°48'	Hydrocast; meter net tow
W62-34A	01 Mar 82	0200	18°43'	79°49'	Neuston tow
W62-35	01 Mar 82	1200	18°37'	80°50'	Hydrocast; meter net tow
W62-36	02 Mar 82	0000	18°31'	81°34'	Neuston tow
W62-37	02 Mar 82	1120	18°32'	82°33'	Hydrocast; phytoplankton tow; meter net tow
W62-38	03 Mar 82	0000	18°34'	82°52'	Neuston tow
W62-39	03 Mar 82	1110	18°44'	83°33'	Hydrocast, meter net tow
W62-40	03 Mar 82	2230	18°04'	84°14'	Isaacs-Kidd Midwater Trawl
W62-41	08 Mar 82	0830	20°32'	87°08'	Meter net tow
W62-42	10 Mar 82	1725	20°40'	86°42'	Sediment scoop
W62-43	10 Mar 82	1913	20°34'	86°39'	Meter net tow
W62-44	11 Mar 82	1755	21°43'	85°57'	Hydrocast; meter net tow
W62-45	12 Mar 82	2140	22°45'	85°29'	Hydrocast
W62-46	13 Mar 82	1200	23°10'	85°23'	Drift bottles released

APPENDIX II. Bathythermograph Summary

Date	Time	BT#	Latitude (N)	Longitude (W)	T_S(°F)
04 Feb 82	1638	1	25°57'	79°53'	77.7
06 Feb 82	2110	2			76.1
07 Feb 82	0200	3	25°47'	77°41'	76.4
07 Feb 82	0845	4	25°43'	77°33'	75.2
07 Feb 82	1050	5	25°47'	77°31'	76.0
07 Feb 82	1105	6	25°49'	77°30'	76.2
07 Feb 82	1120	7	25°49.6'	77°30.4'	76.3
07 Feb 82	2015	8	25°28.7'	77°20.9'	75.2
07 Feb 82	2350	9	25°28.3'	17°10.7'	76.0
08 Feb 82	1130	10	25°36.2'	76°17.7'	75.6
08 Feb 82	1800	11	25°43.5'	76°16.0'	75.9
08 Feb 82	2100	12	25°48.0'	76°02.0'	73.9
08 Feb 82	2255	13	25°51.0'	75°52.5'	73.5
09 Feb 82	0650	14			74.3
09 Feb 82	0849	15			73.6
09 Feb 82	1055	16			73.8
09 Feb 82	1740	17	26°14.4'	75°09.3'	73.8
09 Feb 82	2000	18	26°17'	75°00'	75.5
09 Feb 82	2100	19	26°20.8'	74°50'	75.6
09 Feb 82	2324	20	26°24'	74°36'	74.1
13 Feb 82	2025	21	24°02'	70°34.5'	75.5
13 Feb 82	2330	22	22°44'	70°24.5'	75.8
14 Feb 82	0320	23	23°25'	70°12.0'	75.1
14 Feb 82	0740	24	23°10.5'	69°59.0'	75.5
14 Feb 82	1100	25	22°45.5'	69°51'	77.0
14 Feb 82	1442	26	22°33.5'	69°45.2	77.5
14 Feb 82	1930	27	22°14.5'	69°39.0'	77.0
14 Feb 82	2325	28	22°00'	69°30'	77.0
15 Feb 82	0225	29	29°43'	69°25'	76.7
15 Feb 82	0835	30	21°15.5'	69°12'	76.3

APPENDIX II. (continued)

Date	Time	BT#	Latitude (N)	Longitude (W)	T_S (°F)
15 Feb 82	1330	31	21°00'	69°05.6'	77.0
15 Feb 82	1555	32	20°31'	69°09'	78.0
15 Feb 82	2317	33	20°20'	69°55'	77.5
18 Feb 82	1358	34	20°00'	70°20'	78.9
19 Feb 82	2330	35	20°20'	71°41'	79.5
21 Feb 82	1610	36	19°58'	73°52'	82.0
21 Feb 82	2010	37	19°58'	73°59'	80.6
22 Feb 82	0004	38	19°56'	75°21'	79.9
22 Feb 82	0340	39	19°52'	74°50'	80.1
23 Feb 82	2055	40	19°51'	75°18'	79.5
24 Feb 82	0000	41	19°33'	75°37'	80.6
24 Feb 82	0350	42			78.5
24 Feb 82	0750	43	19°05'	75°55'	80.2
24 Feb 82	1215	44	18°43'	76°15'	80.2
24 Feb 82	1540	45	18°32'	76°24'	80.5
24 Feb 82	1930	46	18°33'	76°41'	80.1
25 Feb 82	0750	47	18°43'	77°23'	80.3
28 Feb 82	1110	48	18°28'	78°48'	26.8 C
01 Mar 82	1105	49	18°46'	80°46'	27.2
02 Mar 82	1100	50	18°31'	82°31'	80.6
03 Mar 82	1110	51	18°44'	83°33'	27.0
04 Mar 82	1120	52	18°55'	84°56'	27.1
04 Mar 82	1138	53	18°55'	85°00'	27.1
08 Mar 82	0827	54	20°32'	87°08'	26.7
10 Mar 82	1830	55	20°35'	86°40'	27.0
10 Mar 82	2002	56	20°34'	86°39'	26.9
11 Mar 82	1745	57	21°43'	88°57'	27.2
12 Mar 82	2140	58	22°45'	85°29'	26.5

APPENDIX III. Summary of hydrocast data

Station	Assumed depth (m)	Calculated depth (m)	Temperature (°C)	Salinity (°/oo)	Dissolved oxygen (ml/l)	Silicate (ug-at/l)
W62-1	Surface	Surface	25.4			
	50	48	23.97			
	100	87	21.56			
	150	136	18.17			
W62-7	Surface	Surface	23.85	36.678	8.22	12.1
	100	35	23.43	36.697	7.65	14.0
	150	89	23.14	36.693	7.85	12.0
	200	123	22.36	36.828	7.31	13.0
	250	233	20.73	36.773	6.86	11.8
	300	248	19.10	-	7.15	-
W62-8	Surface	Surface	23.85	36.690	7.14(?)	10.2
	80	71	22.63	36.793	7.39	10.4
	150	151	20.51	36.745	7.19	10.0
	200	201	19.14	36.626	7.40	10.6
	250	250	18.39	36.547	7.34	10.8
	300	298	17.96	36.503	7.15	11.0
W62-10	Surface	Surface	23.17	36.739	7.89	
	70	60	22.43	36.701	7.73	
	150	140	19.96	36.577	7.28	
	200	199	18.55	36.608	7.32	
	250	241	17.81	36.573	7.97	
	300	289	17.09	36.406	7.06	
W62-11	Surface	Surface	23.42	36.693	7.81	
	35	25	22.40	36.705		
	150	135	19.81	36.642		
	200	199	18.79	36.590	7.27	
	250	242	18.26	36.543		
	300	290	18.08	36.539	7.44	

APPENDIX III. (continued)

Station	Assumed depth (m)	Calculated depth (m)	Temperature (°C)	Salinity (°/oo)	Dissolved oxygen (ml/l)	Silicate (ug-at/l)
W62-12	Surface	Surface	24.02	36.662	7.65	
	70	52	33.59	36.690		
	150	149	20.12	36.618	8.12	
	200	167	19.73	36.650		
	250	222	18.72	36.626		
	300	264	18.25	36.519	7.32	
W62-25	Surface	Surface	25.95	36.454		
	65	74	25.63	36.731		
	100	100	24.69	36.874		
	150	-	22.33	36.698		
	200	133	20.09	36.299		
	300	218	17.95	36.098		
W62-27	Surface	Surface	26.76	35.946		
	65	59	25.93	36.083		
	100	96	25.62	36.224		
	150	156	23.03	36.884		
	200	-	26.63	35.887		
	300	292	17.60	36.410		
W62-31	Surface	Surface	18.49	36.625		
	50	-	21.92	36.888		
	100	-	23.98	36.916		
	150	213	24.50	36.363		
	200	-	26.40	35.785		
	300	-	26.41	30.807		
W62-34 (shallow)	Surface	Surface	27.09	35.754		
	50	47	26.75	36.878		
	100	102	26.72	35.773		
	125	123	26.53	36.200		
	130	129	26.40	36.303		
	135	136	26.28	36.258		

APPENDIX III. (continued)

Station	Assumed depth (m)	Calculated depth (m)	Temperature (°C)	Salinity (°/oo)	Dissolved oxygen (ml/l)	Silicate (ug-at/l)
W62-34	140	131	26.33	36.254		
(deep)	145	140	26.21	36.337		
	150	143	25.93	36.393		
	155	147	25.37	-		
	160	152	24.97	36.620		
	200	193	21.90	-		
W62-35	Surface	Surface	27.06	35.856		
(shallow)	50	50	26.94	35.856		
	75	74	26.95	36.834		
	80	80	26.92	35.837		
	85	89	26.85	35.937		
	90	-	26.60	35.952		
(deep)	95	91	26.56	35.926		
	100	93	26.39	36.004		
	125	115	25.87	36.484		
	140	141	24.78	36.742		
	155	156	23.75	36.810		
	170	170	23.05	36.806		
W62-37	Surface	Surface	27.01			
(shallow)	60	-	26.95			
	75	81	26.97			
	85	88	26.95			
	90	95	26.92			
	95	108	26.92			
(deep)	100	84	27.01			
	105	91	27.00			
	130	116	26.63			
	145	130	26.35			
	160	144	24.86			
	175	163	24.00			

APPENDIX III. (continued)

Station	Assumed depth (m)	Calculated depth (m)	Temperature (°C)	Salinity (°/oo)	Dissolved oxygen (ml/l)	Silicate (ug-at/l)
W62-39	Surface	Surface	27.01	35.86		
(shallow)	60	67	26.95	37.09		
	75	81	26.97	36.21		
	85	88	26.95	36.02		
	90	95	26.92	-		
	95	108	26.92	-		
(deep)	120	130	25.84	36.79		
	125	133	25.60	36.543		
	130	140	25.55	36.557		
	145	-	25.60	36.686		
	160	168	23.47	36.783		
	175	185	22.01	36.805		
W62-44	-	34	26.32	35.98		4.74
(Pretripped	-	554	17.86	36.57		6.22
station)	-	412	13.22	35.75		10.6
	-	487	10.99	36.01		14.9
	-	1486	4.32	35.25		18.3
	-	1495	4.29			18.3
	-	862	6.08	34.71		-
W62-45	Surface	Surface	26.15	36.29		-
(shallow)	200	189	22.93	36.83		-
	400	375	16.66	36.17		18.2
	600	571	11.38	35.29		22.2
	800	751	7.19	34.98		22.2
	1000	952	5.54	34.90		22.5
(deep)	1200	- *	17.74*	36.29*		5.7*
	1400	1260	4.83	35.21		18.3
	1600	-	4.47	34.94		18.3
	1800	1616	4.28	35.14		18.3
	1900	1838	4.25	34.75		18.3
	2000	1822	4.24	34.87		18.3

*Pretripped bottle.

APPENDIX IV. Bird Sightings

Regular Watches

Date	Latin Name	Common Name	Position	No. seen
2/3	*Larus atricilla*	Laughing Gull	18°32' 82°08'	1
2/5	*L. atricilla*	Laughing Gull	26°68' 78°57'	20
2/6	*Sterna* spp.	Terns (unidentified)	25°51' 78°13'	33
	Stercorarius pomarinus	Pomarine Jaeger	25°51' 78°13'	1
2/7	*L. argentatus*	Herring Gull	25°43' 77°34'	1
	Puffinus lherminieri	Audubon's Shearwater	25°45' 77°34'	1
2/15	*Sula* spp.	Boobies (unidentified)	20°00' 69°00'	38
2/16	*Sula* sp.	Booby	20°19' 68°53'	1
	P. lherminieri	Audubon's Shearwater	20°15' 69°56'	1
2/17	*Fregata magnificens*	Magnificent Frigatebird	20°12' 68°51'	1
2/20	*Sterna anaethetus*	Bridled Terns	20°10' 71°46'	60
2/21	*Sterna* sp.	Tern (unidentified)	19°58' 73°52'	1
2/24	*Sula sula*	Red-footed Boobies	18°34' 76°22'	45
	Fregata sp.	Frigatebird	18°13' 76°11'	1
	S. sula	Red-footed Boobies	19°30' 76°11'	34
2/24	*Sterna* spp.	Terns (unidentified)	18°32' 76°24'	25
2/28	*Sula* sp.	Booby (unidentified)	18°46' 76°55'	1
3/1	*S. sula*	Red-footed Booby	18°46' 80°41'	1
	Sula sp.	Booby (unidentified)	18°46' 80°41'	1

APPENDIX IV. (continued)

Date	Latin Name	Common Name	Position	No. seen
3/4	*Sula dactylatra*	Blue-faced Booby	18°35' 85°13'	1
3/5	*Hydroprogne caspia*	Caspian Tern	19°42' 86°54'	1
	Fregata magnificens	Magnificent Frigatebird	20°23' 87°55'	3
3/7	*F. magnificens*	Magnificent Frigatebird	20°31' 87°05'	1
	L. atricilla	Laughing Gull	20°31' 87°05'	1
3/10	*S. anaethetus*	Bridled Tern	20°40' 86°55'	1
		TOTAL		275

Incidental Bird Sightings

Date	Latin Name	Common Name	Position	No. seen
2/6	*Larus argentatus*	Herring Gull	25°47' 78°08'	1
	L. delawarensis	Ring-billed Gull	25°47' 78°08'	1
	L. atricilla	Laughing Gull	25°47' 78°08'	1
	Pterodroma hasitata	Black-capped Petrel	25°47' 78°08'	1
	Puffinus lherminieri	Audubon's Shearwater	25°47' 78°08'	1
2/7	*L. argentatus*	Herring Gull	25°37' 77°35'	1
	L. argentatus	Herring Gull	25°38' 77°35'	6
	L. argentatus	Herring Gull	25°39' 77°33'	2
	L. delawarensis	Ring-billed Gull	25°41' 77°31'	1
	L. atricillia	Laughing Gull	25°49' 77°50'	1
2/8	*Stercorarius pomarinus*	Pomarine Jaeger	25°33' 76°29'	1

APPENDIX IV. (continued)

Date	Latin Name	Common Name	Position	No. seen
2/8	*L. argentatus*	Herring Gull	25°33' 76°29'	1
	L. argentatus	Herring Gull	26°00' 75°30'	1
2/10	*Stercorarius pomarinus*	Pomarine Jaeger	25°45' 74°35'	1
2/11	*Sula dactylatra*	Blue-faced Booby	25°45' 72°44'	1
2/13	*Phaethon* sp.	Tropicbird	23°26' 71°24'	1
2/14	*Phaethon* sp.	Tropicbird	23°26' 71°24'	1
2/15	*Sula* spp.	Boobies	21°00' 69°05'	20
2/16	*Fregata magnificens*	Magnificent Frigatebird	19°56' 68°49'	1
2/17	*F. magnificens*	Magnificent Frigatebird	19°20' 68°40'	1
2/18	*Sterna anaethetus*	Bridled Terns	20°01' 70°01'	14
2/19	*Sterna anaethetus*	Bridled Terns	20°20' 71°00'	50
2/20	*F. magnificens*	Magnificent Frigatebird	20°01' 70°41'	1
	S. anaethetus	Bridled Terns	20°01' 70°41'	1
	S. anaethetus	Bridled Terns	20°08' 71°57'	1
	F. magnificens	Magnificent Frigatebird	20°08' 71°57'	1
2/21	*P. hasitata*	Black-capped Petrel	19°59' 73°50'	1
	F. magnificens	Magnificent Frigatebird	19°59' 73°50'	1
	Pandion haliaetus	Osprey	19°58' 73°52'	1
	Puffinus lherminieri	Audubon's Shearwater	19°58' 73°78'	1

APPENDIX IV. (continued)

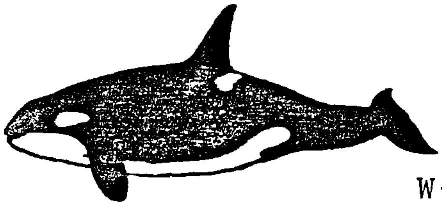
Date	Latin Name	Common Name	Position	No. seen
2/22	*Larus atricilla*	Laughing Gull	18°32' 76°55'	1
	Stercorarius pomarinus	Pomarine Jaeger	18°40' 76°50'	1
	F. magnificens	Magnificent Frigatebird	19°55' 74°24'	1
	Thalassus maximus	Royal Tern	19°55' 74°24'	1
2/28	*F. magnificens*	Magnificent Frigatebird	18°46' 78°36'	6
	S. anaethetus	Bridled terns	18°46' 78°36'	12
	P. haliaetus	Osprey	18°46' 78°36'	1
	Bublucus ibis	Cattle Egret	18°46' 78°36'	1
	Sula leucogaster	Brown Booby	18°46' 78°36'	2
	Passerine sp.		18°48' 78°48'	1
	B. ibis	Cattle Egret	18°48' 78°48'	1
	Petrochelidon pyrrhonota	Cliff Swallow	18°48' 78°48'	1
	Sula leucogaster	Brown Booby	18°48' 78°55'	1
3/1	*S. leucogaster*	Brown Booby	18°46' 78°55'	1
	Sterna spp.	Terns (unidentified)	18°46' 78°55'	52
	Sula sp.	Booby (unidentified)	18°46' 78°55'	1
	Fregata sp.	Frigatebird	18°45' 80°46'	1
	Sula sula	Red-footed Booby	18°45' 80°46'	2
	Sterna anaethetus	Bridled Terns	18°45' 80°46'	18

APPENDIX IV. (continued)

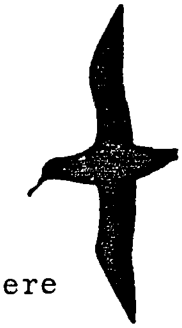
Date	Latin Name	Common Name	Position	No. seen
3/1	F. magnificens	Magnificent Frigatebird	18°45' 80°46'	3
3/2	Sula sp.	Booby (unidentified)	18°31' 81°34'	1
	Thalassus maximus	Royal Tern	18°31' 81°34'	1
	F. magnificens	Magnificent Frigatebird	18°31' 81°34'	1
	S. sula	Red-footed Booby	18°26' 82°19'	1
3/3	Petrochelidon pyrrhonota	Cliff Swallow	18°34' 82°52'	1
	F. magnificens	Magnificent Frigatebird	18°48' 83°50'	1
	F. magnificens	Magnificent Frigatebird	18°41' 83°16'	1
3/4	S. sula	Red-footed Booby	18°41' 83°16'	1
	Stercorarius parasiticus	Parasitic Jaeger	18°49' 84°41'	1
	T. maximus	Royal Tern	18°49' 84°41'	1
	Calidris sp.	Sandpiper (unidentified)	18°49' 84°41'	1
	S. leucogaster	Brown Booby	18°49' 84°41'	1
	F. magnificens	Magnificent Frigatebird	18°49' 84°41'	1
	Calidris sp.	Sandpiper (unidentified)	18°57' 86°12'	1
3/5	Sula sp.	Booby (unidentified)	19°06' 86°30'	1
3/7	F. magnificens	Magnificent Frigatebird	18°57' 86°12'	1
3/8	Larus atricilla	Laughing Gulls	18°57' 86°12'	2
	Amazona spp.	Parrots (unidentified)	18°57' 86°12'	43
		TOTAL		284

APPENDIX V. Tar Distribution

Date	Tow #	Location: Latitude	Location: Longitude	Weight (mg/m^2)
05 Feb 82	W62-3	26°07.4'	78°55'	.0333
07 Feb 82	W62-6B	25°45.3'	77°29.14'	.74
08 Feb 82	W62-9	25°42.76'	76°09.28'	16.19
11 Feb 82	W62-14	25°04.12'	72°44.58'	4.04
12 Feb 82	W62-15	22°53.6'	72°02.3'	1.78
14 Feb 82	W62-18	23°22.5'	69°41.0'	1.19
06 Feb 82	W62-5	25°46.98'	78°08.4'	No tar
17 Feb 82	W62-16	24°03.2'	78°56.2'	.98
14 Feb 82	W62-17	23°40'	70°02'	6.30
19 Feb 82	W62-26	20°09'	70°33'	4.67
24 Feb 82	W62-30	18°13.0'	76°11.5'	.22
28 Feb 82	W62-33	18°32'	78°14'	No tar
01 Mar 82	W62-34A	18°43.2'	79°49'	200+
02 Mar 82	W62-36	18°29.2'	81°33.8'	.89
03 Mar 82	W62-38	18°34'	82°52'	1.48



APPENDIX VI.



W-62, Navidad Bank, Humpback Whale Survey

On 16, 17 Feb. 1982 a series of shipboard transects were done on Navidad Bank in an effort to assess the population of Humpback Whales (Megaptera novaeangliae) on this calving ground (Figure 1, Table 1). There were 129 whale sightings reflecting a total of 182 individuals seen and plotted (Figure 1, Table 2), on the bank. While eight fluke photos were taken, none of the photographs were of sufficient detail to allow for positive identification of the individuals. The major obstacle during the survey (which was not overcome) was the weather and sea state. On 16 Feb., observers had greater visibility which accounts for the range of sightings on T1 and T2 (Figure 1), whereas squalls and higher seas permitted only a narrow census range on T3', T3 and T4 (Figure 1). Due to cloud cover, sun lines could only be rarely obtain to accurately determine Westwards' location, as a result, dead reckoning was used most of the time. On Transect 2 however, the log reading located Westward only halfway up the transect line at 1500 hrs., while the fathometer trace indicated Westward sailed off the bank at 1514 hrs., suggesting that our locations are only best guess estimates.

Unfortunately, the denser packing of animal, on T4 (Figure 1) does not necessarily mean that the humpbacks are more abundant on the western edge of the bank. The difference may reflect a temporal pattern of behavior or result from the animals seeking a preferable area to weather out the sea conditions. As for the distribution of the animals, the majority of the sightings (68%)

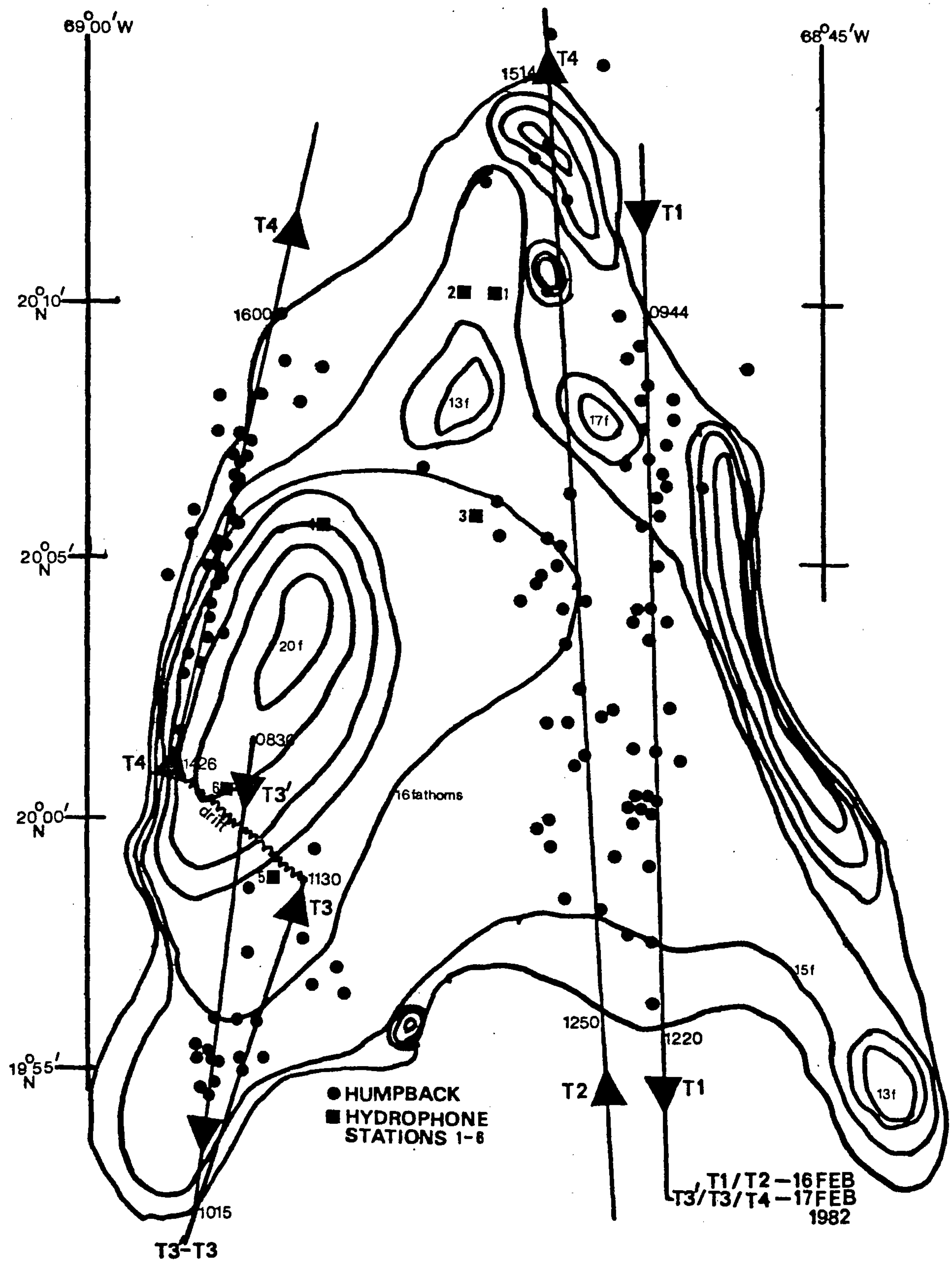
and the plurality of the animals (48%) were recorded as single individuals (Table 2). of the 41 sightings of multiple groupings, 12 were confirmed cow-calf pairs. One sighting of 4 animals was actually two cow-calf pairs traveling in tandem. Again, due to weather and poor photographs we were not able to determine whether or not the non cow-calf pairs were made up of individuals from the same or different feeding grounds. Also, we were unable to assess the length of the animals which could be used as an indicator of age by size class. Data collected by other researchers in the area indicated that some juvenile animals were seen on the banks and were occassionally seen as pairs from the same feeding ground. One 2 year old Humpback (Vega) was photographed off Puerto Rico in mid February by D. Matilla with a second juvenile Humpback from Cape Cod Bay. On 20, March, Vega was rephotographed in Cape Cod Bay by T. Rumage paired with still another juvenile previously reported from Cape Cod Bay. This data is important in two ways, first it clearly documents juveniles migrating south but also provides the shortest travel time from the Caribbean to Cape Cod currently on record.

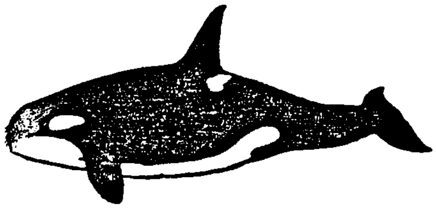
In regards to courtship, six (6) hydrophone stations were monitored on the bank (Figure 1, Table 3). Humpback Whales were recorded at all six stations, but the clearest recordings were from Station 3. Station 3, based on the survey data (note: station 3 was not a transect so population distribution is speculative) appeared to have few animals in that region. What was quite striking was the number of non singers confirmed in the area of Stations 4 and 5 (Table 3). These animals were confirmed as non singers both by volume of the sound but more importantly by the fact that the song was not interrupted by the surfacing of these animals. The distribution of the singers would indicate that they are more limited in distribution than non singers, and that the banks may be primarily a calving ground with mating taking plase either off the banks or in a different region all together. It would have been preferable to make another recording around 0200 on 18, Feb. to confirm that the results from Station 3 reflected a geographical, not temporal, limitation.

The 182 animals represent the maximum size of the minimal population estimate. Whenever the sightly data indicated that the animals might have been previously recorded, these animals were not retabulated. However, due to the lack of fluke photographs we cannot determine if the animals seen on the Western side of Navidad on 17, Feb. included any individuals seen on 16, Feb. Currently there is no available data on relative movement of animals on the bank and I therefore assumed no overlap in the animals from 16 and 17, Feb.

While our stay on the Bank was limited, we did obtain some very good tapes which have been sent to Dr. R.Payne for analysis plus a good indication of the number of animals and their social arrangement was ascertained. The population survey will be useful when compared with data gathered by other groups from Puerto Rico and Silver Bank as an indicator of population movement.

W-62
NAVIDAD BANK
HUMPBACK WHALE SURVEY





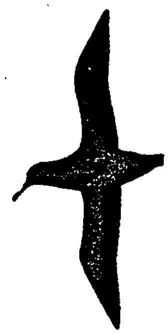


TABLE 1

W-62, Navidad Bank, Humpback Whale Survey
Transect Data

Transect #	Date	Start Time	End Time
1	16 Feb.82	0944	1220
2	16 Feb.82	1250	1514
3'	17 Feb.82	0830	1015
3	17 Feb.82	1015	1130
4	17 Feb.82	1426	1600

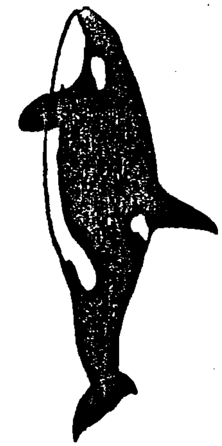
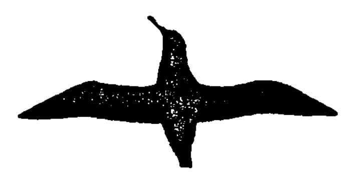


TABLE 2

W-62, Navidad Bank, Humpback Whale Survey
Animal Distributions

Transect #	Singles	Duo	Trio	Quartet	# Sightings/ Transect	# Animals/ Transect
1	27	5	1	1	34	40
2	23	13	0	0	36	53
3'	6	3	0	0	9	12
3	14	2	0	0	16	18
4	18	10	3	3	34	59
# sightings/class	88	33	4	4	129 sightings	
(%/class)	(68)	(26)	(3)	(3)		
# animals/class	88	66	12	16		182 animals
(%/class)	(48)	(36)	(7)	(9)		



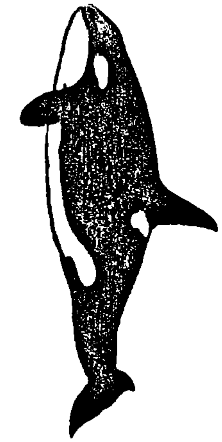


TABLE 3

W-62, Navidad Bank, Humpback Whale Survey
Listening Stations

Hydrophone Station#	Date	Time	Tape#	Comments
1	16 Feb.82	1800-1820	W-62n-1	Tow in progress, whalesheard
2	16 Feb.82	1845-1945	W-62-n-2/2A	1 animal-20yds to stern-not singing, whalesheard
3	17 Feb.82	0205-0335	W-62-n3/3A(P1/P2)	Singers very close
4	17 Feb.82	0550-0720	W-62-n 4(P1/P2)14A	8 nonsingers in area, distant singers
5	17 Feb.82	1150-1320	W-62-n 5(P1/P2)15A	6 non singers hearby, distant singers
6	17 Feb.82	1815-2015	W-62-n6(P1/P2)16A(P1/ P2)	Distant animals