CRUISE REPORT

C-190

SCIENTIFIC ACTIVITIES UNDERTAKEN ABOARD THE SSV Corwtih Cramer

St. Croix – Carriacou – Key West, FL

29 November 2003 to 8 January 2004

Photo by Nathaniel Cameron

Sea Education Association
Woods Hole, Massachusetts

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Preface

This cruise report outlines the scientific research conducted on board the *SSV Corwith Cramer* during cruise C-190 in the winter of 2003 - 2004. Included are abstracts and abbreviated results of student research projects which serve as a summary of the oceanographic research carried out on the cruise, as well as a complete list of sampling stations and collected data. This report is not intended as a final analysis or interpretation of the data generated during C-190. Detailed cruise logs and full student reports are available through Sea Education Association and the Chief Scientist.

The *SSV Corwith Cramer* left from St. Croix on November 29th. The students were nervous, eager and perhaps just a bit afraid. Despite all the classes on shore there is little one can do to prepare for the feeling when casting off the dock lines for the start of a long offshore passage? Before there was time to feel seasick the students had completed their first science station. And without a moments rest we headed to the southeast and the Lesser Antilles Islands, the area of focus for many of our science projects. As luck would have it our course was also to windward, so the students quickly became accustomed to tacking and gibing the *Cramer* in pursuit of our science stations. Within a week we were sailing south in the lee of one tropical island after another, the students already old-salts at sail handling and deploying scientific gear. Before long we were dropping anchor off Carriacou our first and only port stop.

One and all enjoyed their time ashore whether it be hiking, swimming or tasting the local cuisine. It was here that we said farewell to Siobhan Sheerar a guest participant from Woods Hole and welcomed aboard Patricia, a guest participant from Venezuelan. Upon leaving Carriacou we sailed south across the Grenada Passage, and as we neared the South American coast we turned west and sailed with the wind. Sailing along the coast of Venezuela we maneuvered around the numerous coastal islands in pursuit of more data for oceanography projects. After a great view of the Islas de los Roques we headed north-west crossing the Caribbean towards the Jamaica and the Windward Passage. Along the way we paid homage to the Winter Solstice (December 21st) with a rousing Ship's Olympics and a few days later we celebrated Christmas with an all-hands brunch and Secret Santa exchange in the morning. Near the Windward Passage we headed due west with the following challenge given to the students, sail to Jamaica with all of our electronic navigation instruments 'turned off'. With the aid of the sun, stars and traditional arts of celestial navigation we successfully made our way to within 4 nm of our destination south of Jamaica! Our last set of oceanography samples were collected shortly thereafter as we traversed the shallow Pedro Bank.

The remainder of the trip was a blur of activity as we sailed through the Yucatan passage, across the Gulf Stream amidst schools of pilot whales and yellow fin tuna and shortly thereafter we were anchored off the shores of Key West. Suring their final week aboard the Cramer students were busily working on oceanography papers, preparing final presentations and successfully completing a scientific mission that examined the circulation patterns and biological distribution of lobster larvae around the Florida Keys. On our final day all hands turned to and gave the *Cramer* a thorough cleaning top to bottom; and that night we celebrated by sharing songs, sea stories and good cheer all around. All were reluctant to end the night but alas all but those on anchor watch turned in for their last night aboard the *Cramer*.

And thus on the morning of January 8th, alongside in Key West, FL, the students and crew of C-190 mustered on the quarterdeck for the final time. A rousing last roll call, presentation of class pins and an all-hands group hug concluded a most memorable sea semester. As students disembarked the *SSV Corwith Cramer* and prepared for their separate adventures hand shakes quickly turned into hugs and smiles were invariably accompanied by tears. C-190 had come to an end but fond memories remained in our hearts.

By all measures C-190 was a veritable success. We logged over 3200 nm under sail and completed 91 scientific stations, in our pursuit of the 12 student oceanography projects. These successes and many others can be attributed to the professionalism and genuine commitment of the crew and the indefatigable spirit of the students who rose to every challenge.

As always, sailing with Captain Jen Irving was a pleasure and a privilege. Her leadership, competence and commitment to the traditional skills of seamanship made for an exceptional sea semester. With his unique blend of stoic professionalism and jovial playfulness Chief Mate Timothy Frush kept the Cramer ship-shape, the crew smiling and everyone on their on their toes. Second Mate TC Collyer wore many hats as both ship's bosun and medical officer. His quiet demeanor reflected well his confidence and skill on deck. Third Mate Gwen Matuszek took the lead on star frenzy and was flawless in her ship handling during science stations. That old salt Rick Hamilton was indispensable as ship's engineer, Santa Claus and fellow sunrise aficionado. He was always there to appreciate the beauty of each morning with hot cocoa in hand. As ship's steward Sarah Kleb kept appeased our appetites and kept our spirits high with her culinary delights and timely witticisms. Three weeks at sea and still we had fresh fruit and vegetables!

Equal with the rest of the crew, the scientific staff of C-190 was a stacked deck. Charlie Soucheray was tremendous as First Scientist. His flawless deployments, meticulous analyses and artistic renditions of the Banana Dance kept the lab running smoothly and the crew laughing. Second Scientist Dana Crosby worked well with students and had them running deployments from the very beginning. Lab was always a lively place with Dana, whether it be her jokes about *Halobates* or silly winkling hats. Alison LaFerriere: took the position of Third Scientist to new levels. Not only did she perform admirably in her role as scientist but her positive energy and creative games kept moral high.

Though the commitment and talent of the staff provided a foundation for a successful voyage, the ultimate success of C-190 must be attributed to the rest of the crew, the students, who rose to every challenge presented to them, not only as individuals, but also as a community of shipmates. Your spirit and energy fostered an environment aboard the *Cramer* that was simultaneously inspirational and supportive, productive and yet committed to having a good time. Thank you for the memories and stories you have engendered. They will live with me always! I cannot imagine a better group of individuals with whom to have shared the realization of this dream that was C-190.

Cheers,

Jeff Schell
Chief Scientist

Table 1. C-190 Crew and Student Participants

Nautical Staff

Captain	Jen Irving
Chief Mate	Timothy Frush
2nd Mate	TC Collyer
3rd Mate	Gwen Matuszek
Engineer	Rick Hamilton
Steward	Sarah Kleb

Science Staff

Chief Scientist	Jeffrey Schell
1st Assistant Scientist	Charlie Soucheray
2nd Assistant Scientist	Dana Crosby
3rd Assistant Scientist	Alison LaFerriere

Students

Lisa Attanasio	University of Delaware
Nathaniel Cameron	Ohio Wesleyan University
Thomas Evans	Kenyon College
Adam Garis	Oregon State University
Courtnay Gerl	University of Denver
Stephenne Harding	Willamette University
Holly Hill	Carlton College
Dena Hodges	College of Charlston
Brekke Holub	Evergreen State College
Margaret MacClary	Oregon State University
Robert McCurdy	University of San Diego
Molly McLain	Oregon State University
Heidi Miller	University of New Hampshire
Skye Moret-Ferguson	Oregon State University
William Rich	Roger Williams University
Marielis Sexto	University of Puerto Rico
Molly Skinner-Day	Evergreen State University
Tracy Staton	Elizabeth City State University
Benjamin Tipton	Kent State University
Lauren Tuori	University of Massachusetts, Amherst
Ryan Walsh	Villanova University
Rebecca Wolk	Brown University

Guest Participants

Siobhan Sheerar from Woods Hole, MA
Patricia Manuitt Brito from Venezuala

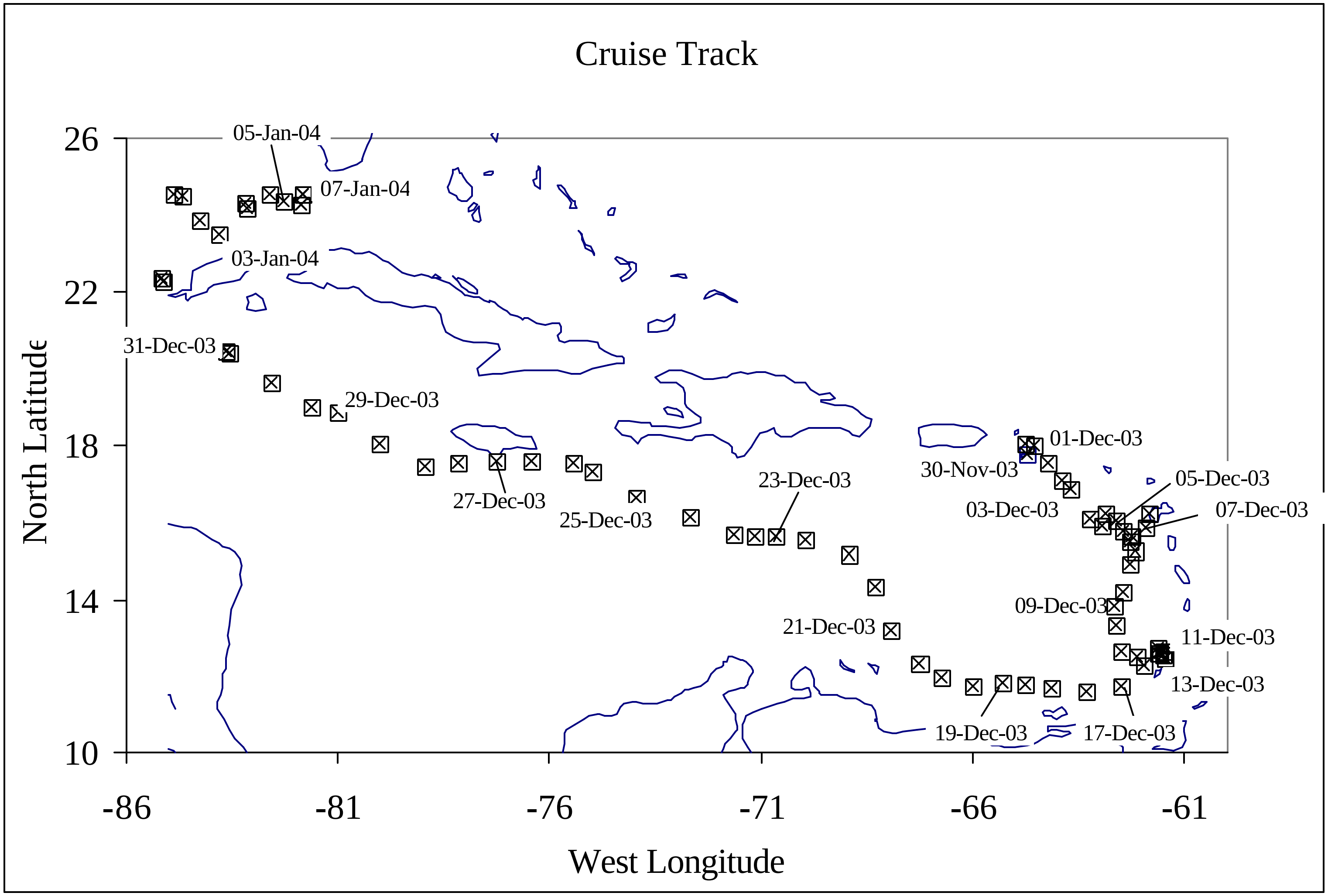


Figure 1. Final cruise track for C-190 based on noon and midnight (local time) positions. Noon and midnight position data are given in Appendix J.

C-190 Academic Program

Cruise C-190 represents the second half of the twelve-week SEA Semester program and consists of two, three-week courses: Practical Oceanography I and II. Academic credits for these courses are granted through Boston University or other affiliates. Letter grades for Practical Oceanography I were determined on the basis of student performance in the following areas: (1) science watch duties, (2) daily, science-updates, (3) Creature Feature presentations, (4) a practical oceanography exam and a (5) report on oceanographic equipment. Practical Oceanography II letter grades were based on student performance in these following areas: (1) several formal presentations and written assignments, (2) student peer-reviews and (3) the final (written) oceanography report. The oceanographic research paper represents the culmination of independent student projects that had been researched and proposed during the Oceanography portion of the shore component.

Throughout the cruise a 24-hour science watch was maintained by an Assistant Scientist and 3 or 4 students. During this time students were instructed in the safe deployment of oceanographic sampling equipment and use of a variety of analytical instrumentation. Science watch standers were responsible for maintenance of the science logbook, conducting scientific stations, recording routine observations and measurements of oceanographic and meteorological conditions and presenting a daily summary of science activities during class. Students were also responsible for the compilation and interpretation of chemical, biological, physical and geological data sets relevant to their individual research projects as well as those of their peers. As C-190 progressed students were given greater responsibility for the successful operation of all lab procedures, culminating in each student being designated as the Lab Coordinator for five to six science watches. At this stage, the efficient operation of the lab and the progress of the scientific program rested almost entirely with the students.

Student academic responsibilities off-watch consisted of attending oceanography class each day. Material covered during class ranged from practical instruction in scientific equipment to timely lectures on regional oceanographic phenomena (Tables 2 and 3). Students prepared several formal presentations for class: Project Introductions, Mid-Cruise Updates, Final Project Reports and Creature Features. Students also analyzed and interpreted data for their independent research projects and edited and revised their research papers as well as those of their peers. Finally, students completed a practical exam that tested their proficiency in science operations and relevant scientific theory.

In summary, the students of C-190 have completed a rigorous academic program that challenged not only their understanding of oceanographic concepts but also how to put those concepts to work in the formulation and completion of independent research projects and in the day-to-day challenges of oceanographic research at sea.

Table 2. Academic Program

* The daily Ship's Meeting began with student-led, reports on Weather, Navigation, Engineering and Science.

Nov.	29	Orientation I:	
		• Deck Orientation: line handling, boat checks, logbook	Mates
		• Hydrowinch operation	Scientists
	30	Orientation II:	
		• Lab, Galley, Engine Room, safety	Scientists, Steward, Engineer
		• Emergency Watch Bill responsibilities	Mates, Jen Irving
Dec.	1	Academic Program:	
		• Nautical Science	Jen Irving
		• Oceanography I and II	Jeff Schell
	2	Project Introductions	Students
	3	Line Chase	Mates
	4	Science Demo/Data Discussion:	
		• Neuston Tow	Scientists
		• DVM in zooplankton	Jeff Schell
	5	Science Demo/Data Discussion:	
		• Hydrocast	Scientists
		• Chemistry at Sea	Jeff Schell
	6	Field Day #1 (Banana Dance introduced!)	Entire crew
	8	Tacking	Timothy Frush
	9	Project Mentor Meetings	Scientists and Jeff Schell
	10	Gybing	Timothy Frush
		Phase II Description * **Change Watch Officers**	Jen Irving and Jeff Schell
	11	Port Stop Discussion / Island History	Jen Irving and Jeff Schell
	12-14	**Carriacou Port Stop**	
	15	Field Day #2	Entire crew
	16-29	Creature Features	Students
	16	Mid-cruise Project Updates	Students
	17	Celestial Review	Jen Irving
	18	Radar plotting	Timothy Frush
	19	Lab Practical	Scientists
	21	Field Day #3	Entire crew
	23	Bioluminescence	Alison LaFerriere
	24	Phase III Description * **Change Watch Officers**	Jen Irving and Jeff Schell
	24-26	No Instrument Run Discussion	Jen Irving
	28	Field Day #4	Entire crew

	30	Peer Review Discussions	Students
	31	Project Mentor Meetings #2	Scientists and Jeff Schell
Jan.	2	Project Presentations	Students
	3	Project Presentations	Students
	5	Bioerosion of Coral Reefs	Patricia Britto (Venezuelan Observer)
	6	Oceanography Presentations	
		• Ocean Dumping	Dana Crosby
		• Lateral Line and Electromagnetism in Sharks	Charlie Soucheray
		• Echolocation	Alison Laferriere
	7	Final Field Day !!	Entire crew
		Presentation of the Florida Keys, Counter-current Investigation	Lisa Attanasio Robert McCurdy Lauren Tuori
	8	C190 ends	

CRUISE SUMMARY

The passage from St. Croix to Key West, FL was a classic cruise track rich in variety of ocean environments and interesting phenomenon providing ample opportunity for student investigations. Students made good use of this potential as can be seen in the breadth of research projects undertaken (Table 4). Many student projects focused on the changes in various oceanographic features as we sailed from one region to the next.

C-190 began in the subtropical waters of the northeastern Caribbean. This area is influenced by central north Atlantic water that enters the Caribbean through the Anegada-Jungfern, Antigua, Guadeloupe and Dominican Passages with its characteristic biotic community (including floating *Sargassum* weed) and low nutrients. As we sailed south of 15°N we experienced oceanographic conditions largely influenced by tropical north Atlantic water and freshwater outflows from the Amazon and Orinoco Rivers that enter the Caribbean through the St. Vincent and Grenada Passages. This area has comparatively higher nutrients and lower temperature and salinity. Cooler temperatures and higher nutrients persist along the South American coast due to localized upwelling events, but consequently salinity is comparatively higher. As we continued to sail west through the central Caribbean these multiple influences resolved themselves into typical Caribbean Sea conditions, warm, salty, strongly stratified and a predominant current flowing east to west.

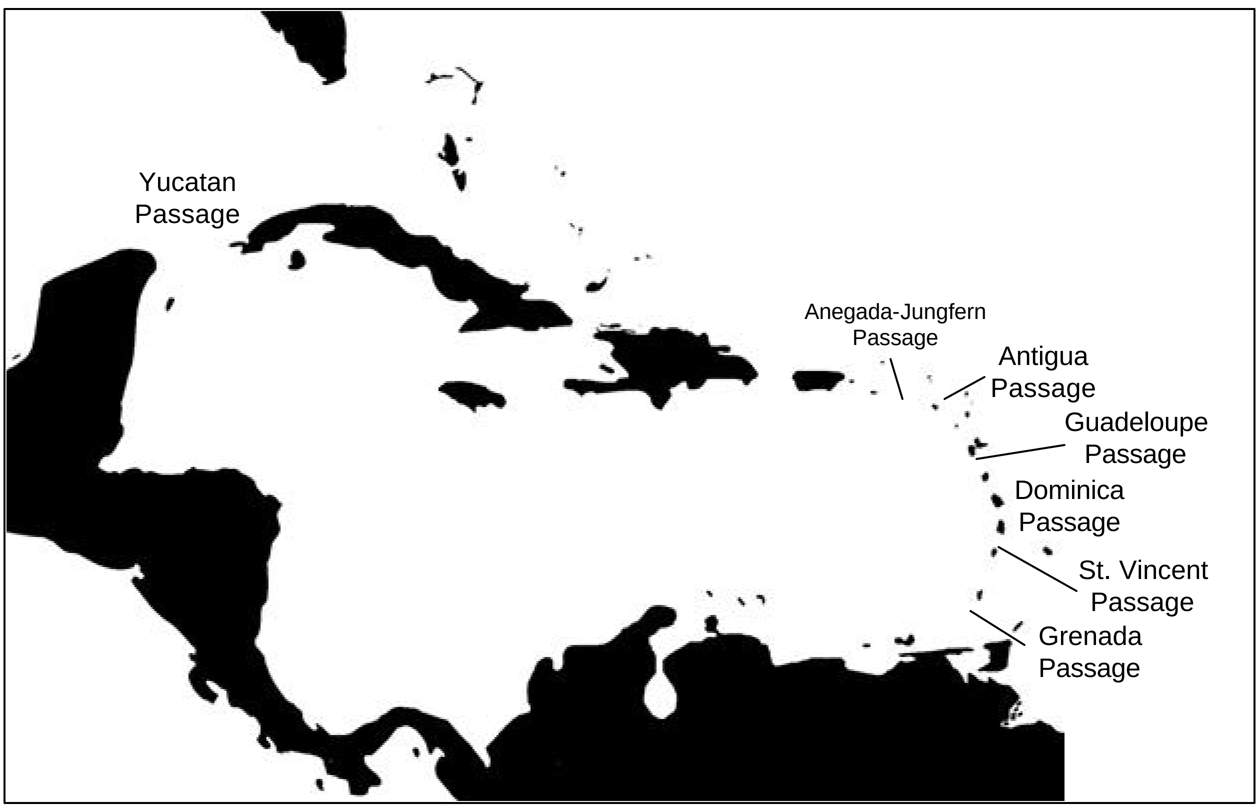


Figure 2. The Caribbean Sea and major island passages.

This brief oceanographic synopsis of the Caribbean area frugally decorates the stage whereupon the students conducted their research projects. What follows are the players and their parts in this oceanographic extravaganza as provided by student abstracts and brief summaries of corresponding data.

Table 4. Student Research Projects

Physical Oceanography

Thomas Evans and William Rich	Island Wake Effect in the Lesser Antilles Island Chain

Chemical/Biological Oceanography

Rob McCurdy, Molly McLain and Heidi Miller	A Comparison of Near Shore, Offshore, and Continental Areas of the Caribbean with a Focus on Plankton Density, Compositions, and Nutrient Concentrations
Margaret MacClary and Marielis Sexto	Analysis of the deep chlorophyll maximum, near-shore as compared to off-shore, as related to the pycnocline in the Caribbean Sea

Biological Oceanography

Lisa M. Attanasio	A comprehensive study of the survival and persistence of lobster phyllosoma in the Caribbean Sea for development of improved aquaculture conditions
Molly Skinner-Day	Present trends in *Halobates micans* distribution and abundance, with correlations to changing ecological conditions in the Caribbean Sea
Skye Morét-Ferguson	Determining the relationship between Euthecosomatous pteropod distribution and Caribbean water masses
Dena Hodges and Tracy Staton	The ecological relationship between macrofaunal communities found among *Sargassum fluitans* and *Sargassum natans* and their age, biomass, and location in the Caribbean Sea
Lauren Tuori and Ryan Walsh	The role rostro-caudal length, lunar phase, and vertical migration patterns have in the foraging habits of myctophids of the Caribbean Sea

Rebecca Wolk	Tracing the distribution and nutrient-dependence of Ciguatera-associated dinoflagellates in benthic macroalgae surrounding two Caribbean islands

Geological Oceanography

Adam Garis and Stephenne Harding	Nutrient input correlated to the carbonate sediment remains in the Antilles Island chain, Jamaica, and off the northern coast of South America
Courtnay Gerl, Holly Hill and Nathaniel Cameron	The Grenada Basin locality, a comparative study of foraminifera, sedimentation and their relationship to paleoclimates and ocean trends

Pollution Studies

Brekke Holub and Ben Tipton	The study of levels of pelagic tar, plastics and nutrient concentrations in the Caribbean waters with emphasis on the islands of Grenada, Jamaica, Guadeloupe and Carriacou

Student Project Abstracts and Data Summary

Island Wake Effect in the Lesser Antilles Island Chain

Thomas Evans and William Rich

Abstract: Island wake effect is a phenomenon in which currents form eddies in the lee of islands as the currents flow through island passages. We hypothesized that island size, passage size and angle of island incidence in relation to the prevailing current would all influence the size of eddies formed in an island's wake. Currents were measured in the lee of several islands of the Lesser Antilles and off the Venezuelan coast of South America using an acoustic doppler current profiler (ADCP). Island size, passage size, and prevailing current speed all effected the formation of island wake eddies. Larger islands had larger eddies and smaller islands had smaller eddies in their wake. Larger island passages brought slower moving currents and smaller passages brought faster currents. Currents that were moving through the passages faster formed larger more defined eddies and slower currents brought about less developed eddies in the lee of the island. Because the majority of the islands examined had similar angles of incidence to the prevailing current, this hypothesis was not considered further. In summary, island wake effect was dependent on island size, passage size and prevailing current speed.

Data Summary:

Several north-south transects were made in the lee of Saba Bank, Guadeloupe, Carriacou, Grenada and Islas Los Roques in order to map the resulting current eddies that formed in the wakes of these islands. Prevailing currents formed a smaller eddy, closer to shore with faster currents in the wake of Carriacou in comparison the larger, slower moving eddy that formed farther from shore in the wake of Grenada (Figure 3). Carriacou is a smaller island with narrower island passages to the north and south whereas Grenada is a larger island with comparatively wider island passages.

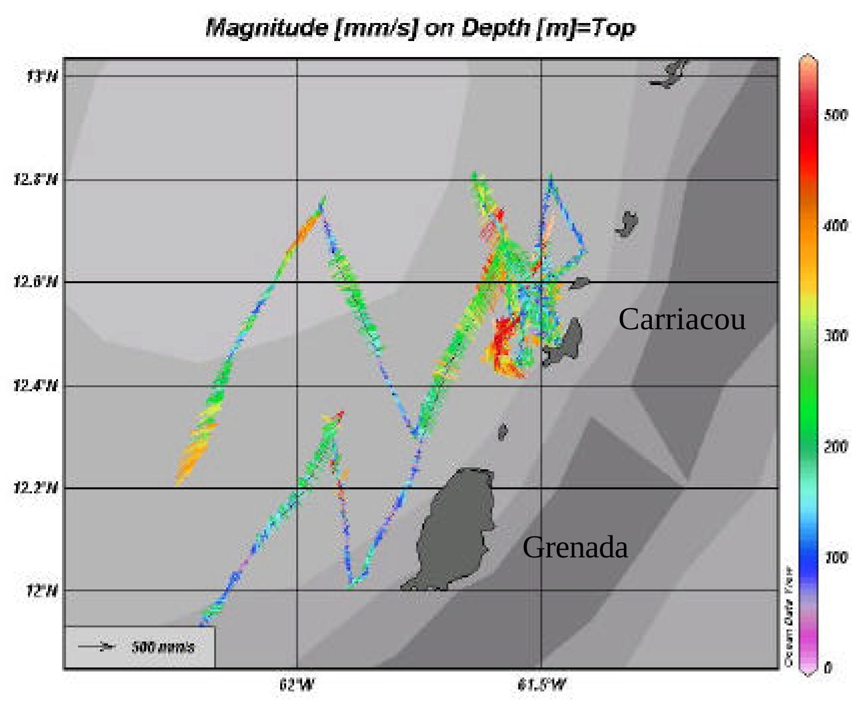


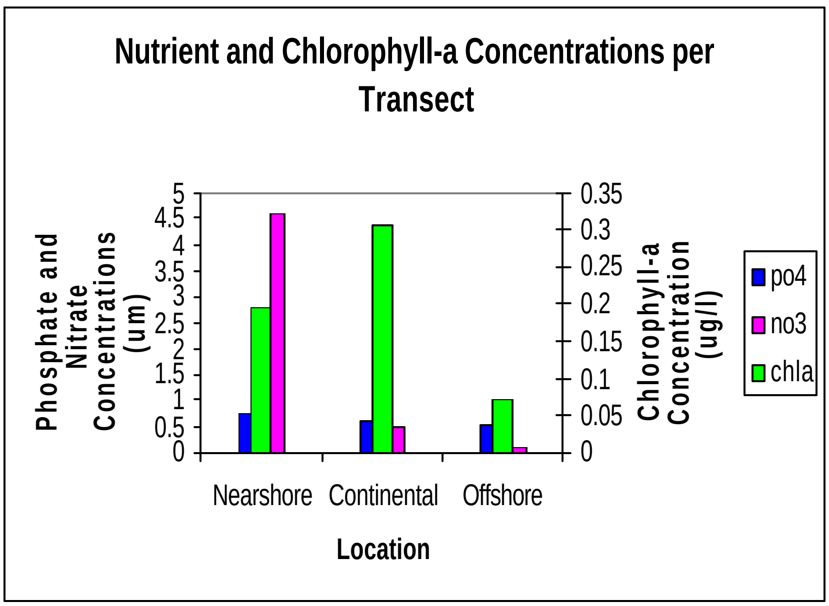
Figure 3. Surface current vectors (mm/s) in the wake of Carriacou (small island) and Grenada (large island) measured during C190. Arrow direction depicts current direction and color depicts current velocity.

A Comparison of Near Shore, Offshore, and Continental Areas of the Caribbean with a Focus on Plankton Density, Compositions, and Nutrient Concentrations

Rob McCurdy, Molly McLain and Heidi Miller

Abstract: This study examined the influence of localized disturbances, such as island wake effect, coastal upwelling and island runoff and river input, on regional productivity in comparison to the relatively low productivity of the Caribbean Sea. Comparisons of regional productivity included measurements of phosphate, nitrate, and chlorophyll-a concentrations, phytoplankton and zooplankton densities, as well as zooplankton diversity. Three regions were compared: the Lesser Antilles Island Chain was an area of island wake disturbance, the northern coast of Venezuela was an area disturbed by coastal upwelling and river runoff, (notably the Orinoco River), while the central Caribbean Sea was considered an area of low disturbance and thus low productivity.

Data Summary:



As predicted, coastal disturbances associated with island wake effect, upwelling and river runoff contributed to regional increases in productivity as estimated by nutrient (phosphate and nitrate) and chlorophyll-*a* concentrations (Figure 4).

Figure 4. Average concentrations of phosphate (po4 - uM), nitrate (no3 - uM) and chlorophyll-a (chla - ug/l) for three geographic regions: Nearshore (Lesser Antilles), Continental (north coast of Venezuela) and Offshore (central Caribbean).

Average densities of dinoflagellates and the nitrogen-fixing cyanobacteria *Trichodesmium* spp were greater in nearshore and continental areas compared to offshore areas. In contrast, diatom densities, which were an order of magnitude greater than dinoflagellates and *Trichodesmium* spp, did not differ among sampled regions. Likewise, average zooplankton density did not follow predicted trends, but was instead similar among all sampled regions.

Analysis of the deep chlorophyll maximum, near-shore as compared to off-shore, as related to the pycnocline in the Caribbean Sea.

Margaret MacClary and Marielis Sexto

Abstract:

We compared the depths of the deep chlorophyll maximum (DCM) from nearshore and offshore stations in relation to pycnocline depth throughout the Caribbean Sea in order to identify areas of increased CO_2 sequestration below the pycnocline. We assumed that CO_2 was more likely to be subducted into the deep ocean waters and taken out of atmospheric circulation in areas where the DCM occurred in or below the pycnocline. The DCM occurred between 50-100 m among nearshore stations and overlapped the pycnocline (34-160 m). In contrast, the DCM in offshore areas occurred between 25-100 m and was on occasion above the pycnocline (61-131 m). Furthermore, the concentrations of observed DCMs were greater among nearshore stations. Our data suggests that CO_2 sequestration below the pycnocline occurs more readily in nearshore stations.

Data Summary:

Six hydrocast stations (CTD with niskin bottles) were conducted nearshore areas to leeward of the Lesser Antilles (station #s 009, 013, 017, 019, 026, 028) to determine the depths of the deep chlorophyll-a maximum layer and corresponding depths of the pynocline (Figure 5). These were compared six hydrocast stations conducted in offshore areas along a north-south transect bisecting the central Caribbean (station #s 045, 052, 060, 062, 064, 070). The data suggest that CO_2 sequestration below the pycnocline would occur more readily in nearshore stations.

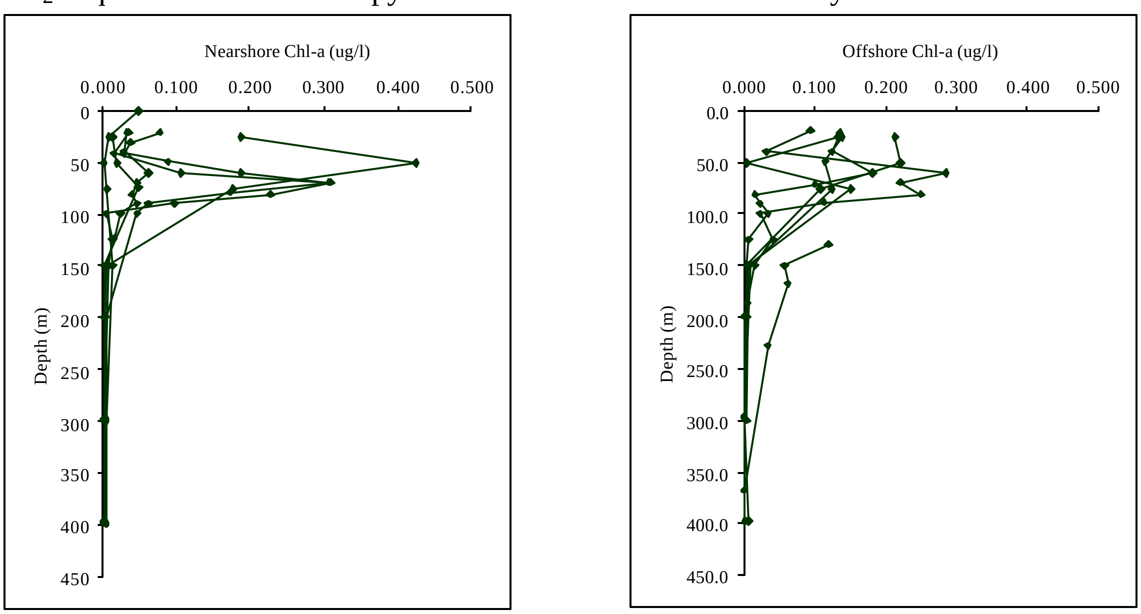


Figure 5. Vertical profiles of chlorophyll-a (ug/l) from six nearshore stations collected along a north-south transect to leeward of the Lesser Antilles and six offshore stations collected along a north-south transect bisecting the central Caribbean during C190. The shaded regions represent the average upper and lower limits of the pycnocline.

A comprehensive study of the survival and persistence of lobster phyllosoma in the Caribbean Sea for development of improved aquaculture conditions

Lisa M. Attanasio

Abstract: Spiny lobster is an economically important species and consequently is cultivated under aquaculture conditions. However, survival rate is only 10% due to difficulties maintaining the species during their phyllosoma (larval) life stage. The purpose of this research was to determine the ideal physical and chemical conditions aquaculture by studying phyllosoma in their natural environment. Parameters examined were temperature, salinity and nitrate, phosphate and chlorophyll-*a* concentrations as well as total zooplankton density and abundance of particular zooplankton species. Phyllosoma populations were expected to be more abundant in regions of moderate salinity and temperature and show a positive relationship with zooplankton biomass and nutrient, and chlorophyll-*a* concentration. Neuston and 1-meter nets were used to collected the phyllsoma and zooplankton, while hydrocasts and surface stations were used to determine temperature, salinity, chlorophyll-*a* and nutrient concentrations. There was no correlation between phyllosoma abundance and temperature, salinity, zooplankton density, nutrient or chlorophyll-*a* concentration. An inverse relationship was observed between phyllosoma abundance and copepod abundance. A positive relationship was observed between phyllosoma numbers and number of fish eggs present. The latter two relationships may be indicative of possible trophic relationships with copepods and fish eggs representing prey items for phyllosoma larvae.

Data Summary:

The physical, chemical and biological parameters examined did not appear to limit phyllosoma abundance in the Caribbean Sea. Phyllosoma occurrence spanned nearly the entire range of temperature, salinity and chlorophyll-*a*. Phyllosoma were not collected at sites exhibiting the highest concentrations of nitrate, phosphate or zooplankton abundance. However, no significant negative trend was detected. Therefore, the original hypotheses of greater numbers of phyllosoma found in regions of moderate temperature and salinity with high concentrations of nutrients, chlorophyll-*a* and zooplankton, were not supported.

	Temperature (oC)	Salinity (psu)	Nitrate (uM)	Phosphate (*u*M)	Chlorophyll-*a* (*u*g/l)	Zooplankton Density (ml/m^2)
Range of Phyllosoma observation	12.4-29.2	34.7-37.5	nd-5.4	nd-0.52	nd-0.15	0.002-0.027
Range of parameter observed	12.4-29.2	33.2-37.8	nd-6.3	nd-0.92	nd-0.20	0.001-0.290

Table 5. The range of physical, chemical and biological conditions coincident with phyllosoma occurrence and for all neuston and meter net tows during C190. nd = non-detectable.

Present trends in *Halobates micans* distribution and abundance, with correlations to changing ecological conditions in the Caribbean Sea

Molly Skinner-Day

Abstract: *Halobates micans* (Heteroptera: Gerridae; sea skater) is the only species of a family of ocean-going insects that has colonized all five of the world's oceans. *H. micans* lives at the air-and-sea interface and is known to be highly sensitive to sea surface temperature (SST), light, and any other changes to this exposed, pelagic environment. Therefore, change in the abundance and distribution of *H. micans* was expected to follow changes in SST. The average SST and catch of *H. micans* was compared among different geographic regions over the last four years of SEA data.

Data Summary:

Average sea surface temperatures in December and January 2003-2004 were the greatest since 1999. Average catch of *H. micans* during this same time period also increased in two of the three geographic regions that were compared (Figure 6). From this limited data set it appears that in these regions of the Caribbean increases in SST are still within the range of optimal conditions for *H. micans* and are able to support increased populations (Table 6).

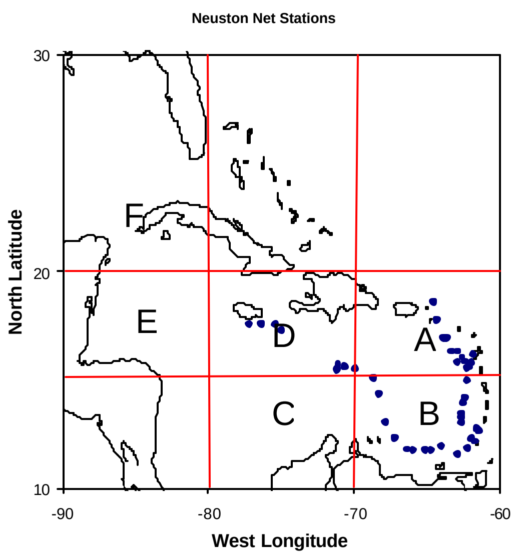


Figure 6. The Caribbean was divided into six geographic regions along lines of latitude and longitude that loosely corresponded to subtropical (A, D) and tropical (B, C) and western Caribbean water masses. Neuston tow locations during C-190 are shown.

Table 6. Average sea surface temperature (^{o}C) and catch of *Halobates micans* in daily noon and midnight neuston tows during C-190 cruise track.

Temp ^{o}C	**1999**	**2000**	**2001**	**2002**	**2003**
A	26.6	27.1	27.1	27.5	28.2
B	26.9	27.5	27.1	27.0	27.9
D	27.2	27.4	27.8	26.4	27.9
***H. micans* #**					
A	no data	6	no data	3	6
B	no data	2	no data	5	10
D	7	3	no data	no data	9

Determining the relationship between Euthecosomatous pteropod distribution and Caribbean water masses

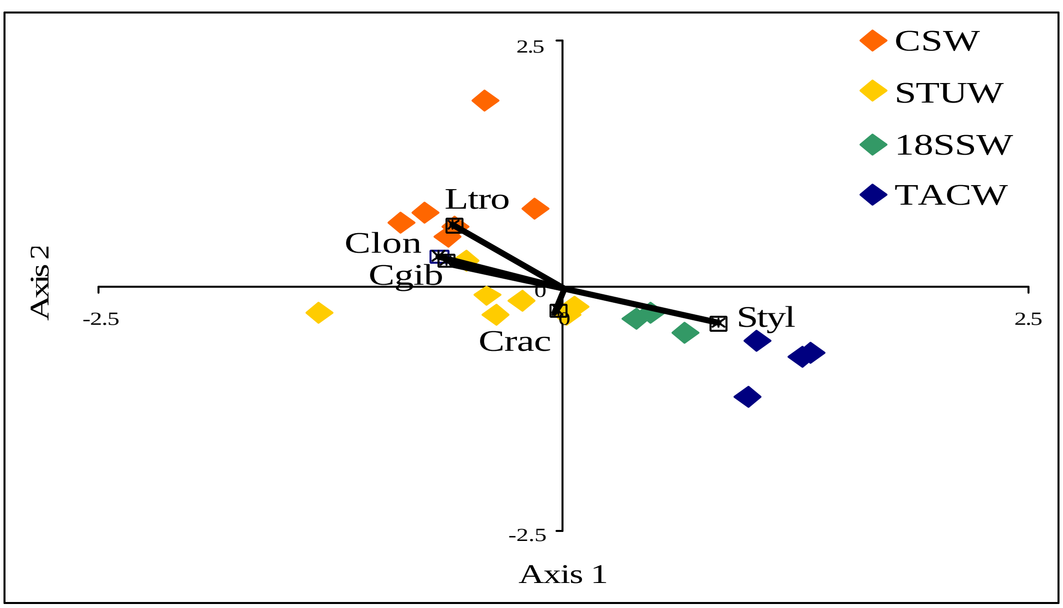
Skye Morét-Ferguson

Abstract: During the course of the *SSV Corwith Cramer* cruise track from St. Croix, USVI to Key West, Florida, we examined the relationship between pteropod species densities and four Caribbean water masses, Caribbean Surface Water (CSW), Subtropical Underwater (STUW), 18°C Sargasso Sea Water (18SSW) and Tropical Atlantic Central Water (TACW). Geographic location and depth distribution of these four water masses were identified at seven study sites in the Caribbean. Zooplankton nets were towed at three depths to collect pteropods. A sub-surface salinity maximum layer (110-200m) was present at all study sites, indicating the presence of STUW. A sub-surface layer of higher oxygen content (below 200m) was present at three study sites, reflecting the presence of 18SSW in our northern and western Caribbean stations. TACW occurred below 200m at all other stations. More species were found in 18SSW than in TACW. The densities of several pteropod species were correlated with the presence of CSW, STUW and 18SSW. The following pteropods: *Cavolinia gibbbosa*, *C. longirostris*, *Creseis acicula* and *Limacina trochiformis* were more common in the upper 200m (CSW and STUW). *Styliola subula* was indicative of 18SSW. These findings suggest that reconstruction of paleoceanographic conditions can be accomplished by examining pteropod remains in sediment cores. The presence or absence of indicator species in successive sediment layers may reveal historic distributions of water masses in the Caribbean Sea.

Data Summary:

Several pteropods were identified as being indicative of particular water masses in the Caribbean Sea (Figure 7).

Figure 7. Nonmetric multidimensional scaling of 20 meter net samples from four Caribbean water masses arranged in environmental space (temperature, salinity, density and oxygen content). Species correlation vectors indicate relationships among net samples and pteropod species: *Limacina trochiformis* (Ltro), *Cavolinia longirostris* (Clon), *Cavolinia gibbosa* (Cgib) and *Creseis acicula* (Crac).



The ecological relationship between macrofaunal communities found among *Sargassum fluitans* and *Sargassum natans* and their age, biomass, and location in the Caribbean Sea

Dena Hodges and Tracy Staton

Abstract: The main problem investigated in this study was determining major factors that influence *Sargassum* communities in the Caribbean Sea. Four factors were tested: *Sargassum* location, age, size, and species in relation to their macrofaunal communities present. Dip nets and neuston tows were used to collect samples. The neuston tow samples were used strictly for distribution and location purposes, while the dip net was used to study the organisms themselves. The results showed that *Sargassum* tended to increase in age, as well as clump size, as it was found further west in the cruise track. Also, as older *Sargassum* was found, it tended to have a smaller organism biomass as compared to that of younger *Sargassum*. Finally, *S. fluitans* and *S. natans* tended to show relatively the same biodiversity, even though *S. fluitans* had a greater organism abundance than did *S. natans*. It was concluded that *Sargassum* communities are very complex and require much additional research to more fully understand them.

Data Summary:

Age of *Sargassum* weed was estimated using a relative color scale. A yellow-green color of floats and leaves represents recent plant growth. Increasingly brown coloration represented older plant material that is beginning to senesce. There was a clear trend that as the age of *Sargassum* plant increased the number of macroorganisms (> 1cm) increased.

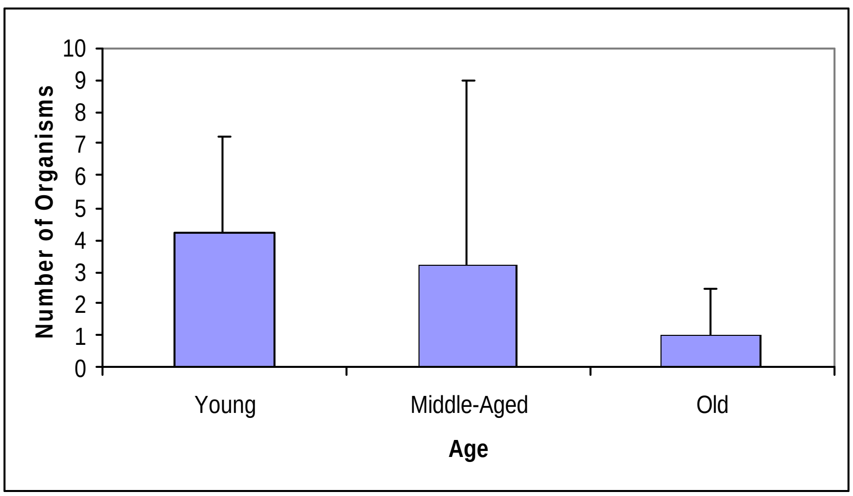
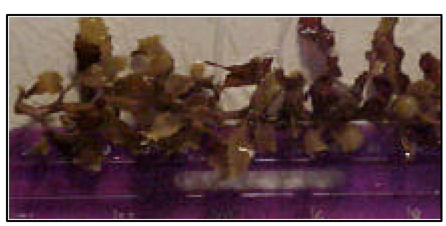


Figure 7. Average number of macrooganisms collected in Dip Net samples for Young (n=16), Middle Age (n=15) and Old (n=2) *Sargassum*. Examples of Young and Old *Sargassum* are also shown.



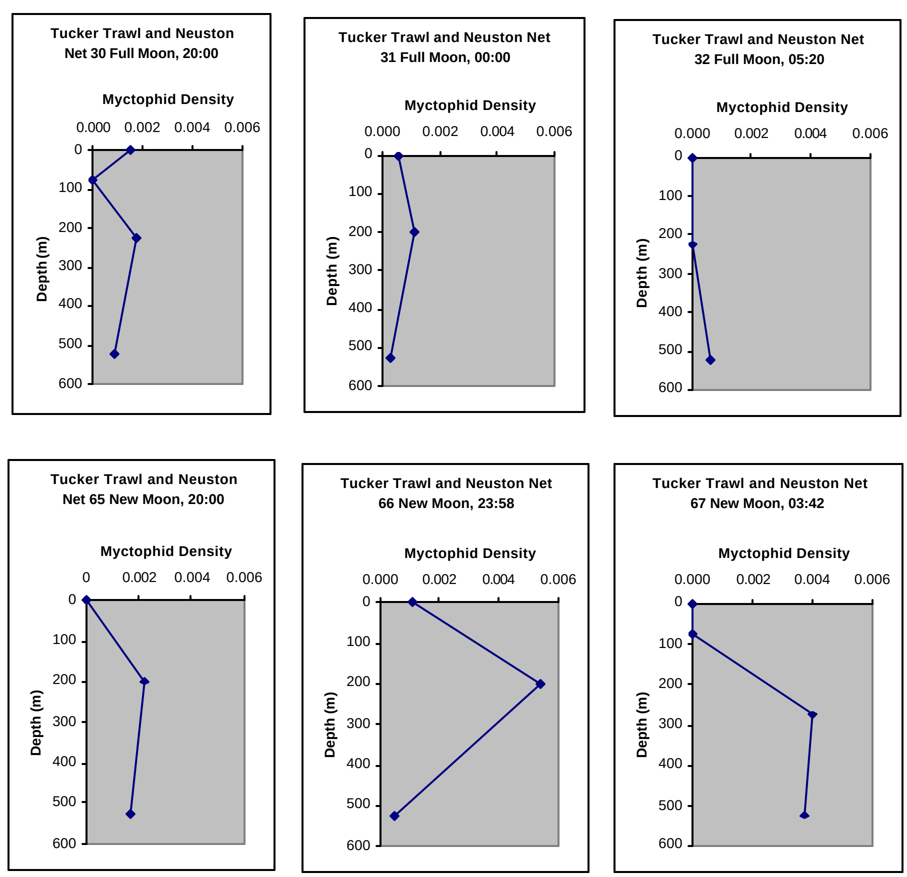
The role rostro-caudal length, lunar phase, and vertical migration patterns have in the foraging habits of myctophids of the Caribbean Sea

Lauren Tuori and Ryan Walsh

Abstract: The role of the biological pump as a means of carbon sequestration is an important part of our environment. Myctophids, members of the active flux component of the pump, have been shown in the past to migrate to the surface through diel vertical migration. This migration leads to foraging and ends in the defecation of carbon containing detritus. We hypothesized that myctophids would surface at night and then return to the depths where they would defecate below the pycnocline. Due to the depth of this defecation the carbon would be successfully sequestered. In order to consider all aspects of this migration we collected data on both the full and new moon so that lunar effect could be studied. Individual data sets were collected on rostro-caudal length, gut fullness, myctophid density, and zooplankton density. All components were brought together to show what role, if any, myctophids play in the biological pump. While we predicted that myctophids ingest a substantial amount of zooplankton at the surface during the night hours and then defecate at a much greater depth, our results show a different foraging pattern of no marked feeding at the surface. Furthermore, we explored the foraging depths of myctophids around new and full moons, and determined that lunar brightness affects vertical migration and foraging habits. Finally, we found a correlation between foraging depth and body length, indicating that different myctophid species may search for food at different depths.

Data Summary:

Figure 8. Myctophid density is plotted against the depth at which the samples were collected for both the new and full moon over the course of a night. Data points are the average depth at which each net towed. Myctophid density was higher during the new moon than the full moon. During both lunar phases density peaked at depths of 200-300 meters during all tows except the final deployment on the full moon.



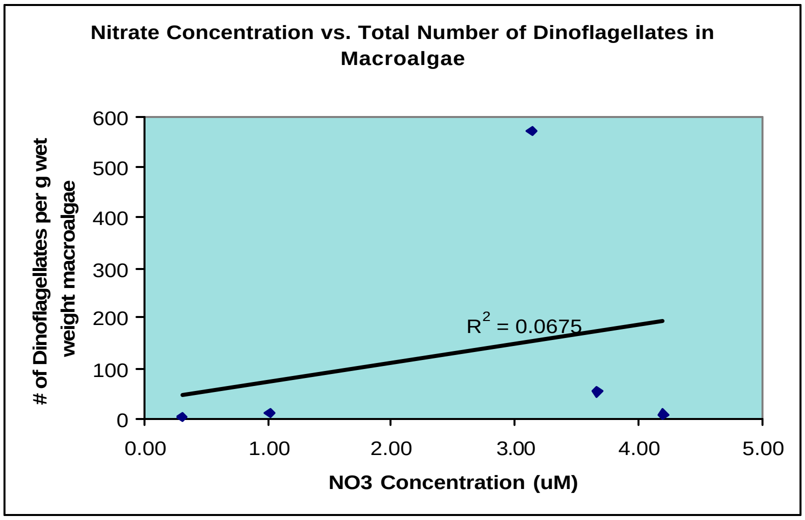
Tracing the distribution and nutrient-dependence of Ciguatera-associated dinoflagellates in benthic macroalgae surrounding two Caribbean islands

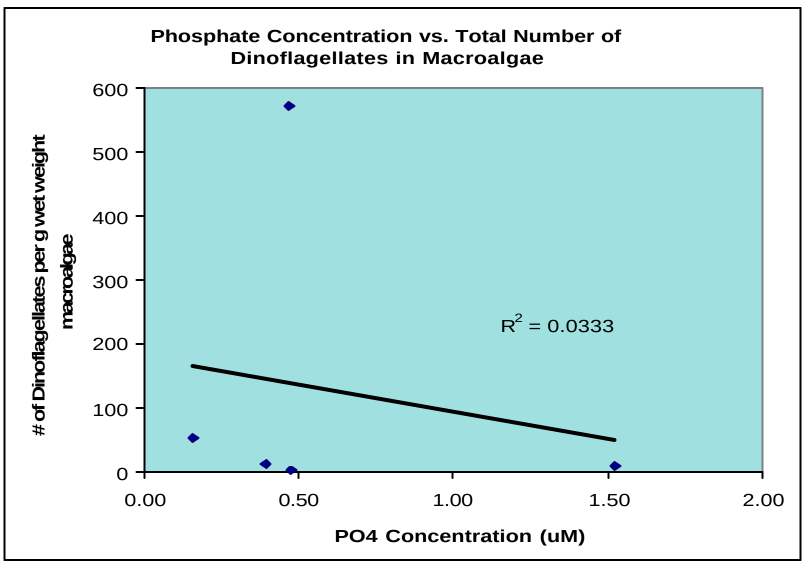
Rebecca Wolk

Abstract: Ciguatera-causing dinoflagellates were collected and analyzed along with nutrient data for nitrate and phosphate to assess a relationship between increasing nutrients and dinoflagellates densities. On the islands of St. Croix and Carriacou, a total of five benthic locations were sampled by collecting macroalgae and performing microscope counts of the toxic dinoflagellates. Out of 8 dinoflagellate species found, no correlation was found between dinoflagellates densities and nutrient concentrations. Nutrient data was also compared between St. Croix and Carriacou to assess if the nutrient concentrations were higher on the larger island of St. Croix. Only a nitrate gradient confirmed the hypothesis that nutrients would be higher on the larger islands.

Data Summary:

Figure 9. The relationship between density of Ciguatera-causing dinoflagellates and nutrient concentrations (uM) for a) nitrates and b) phosphates. Density of dinoflagellates was measured as the number occurring per wet weight of benthic macroalgae sampled. Corresponding R^2 values indicate that these relationships were not significant.





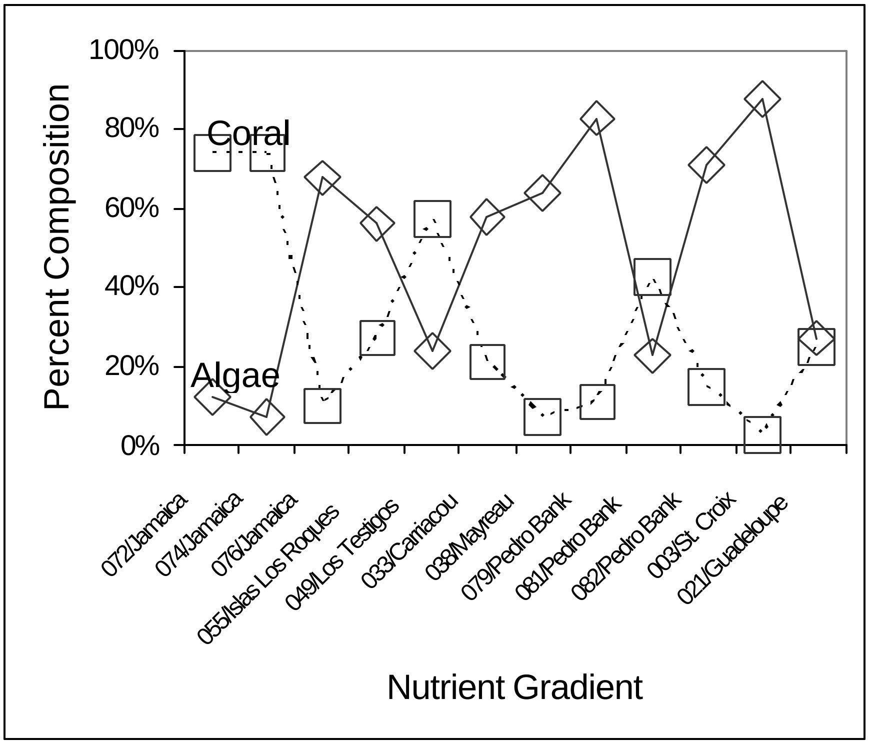
Nutrient input correlated to the carbonate sediment remains in the Antilles Island chain, Jamaica, and off the northern coast of South America

Adam Garis and Stephenne Harding

Abstract: This research investigated the hypothesis that there is a nutrient gradient formed by island size which forms an inverse relationship with coral production. Hence, the more coral produced the fewer nutrients, the more nutrients, the fewer coral remains. Samples were taken from 4 major oceanographic regions: large islands, small islands, banks and terrestrial river flow. This was performed by analyzing calcium carbonate remains which were collected from near shore locations using a shipek grab. These remains were then 100 counted to find a percent composition and compared to the island size, phosphate and temperature measurements for their corresponding locations. The comparison between composition of carbonate sediment remains and island size, phosphates, and temperature revealed no correlations and did not support our hypothesis. The simplification of coral production to a single gradient maybe the reason there is no correlation.

Data Summary:

Figure 10. The relationship between phosphate concentrations and percent composition of coral and coralline algae remains in the sediment among Caribbean Islands. The phosphate gradient ranged from 2.2 uM near Jamaica to less than 0.05 uM at a station near Guadeloupe.



The Grenada Basin locality, a comparative study of foraminifera, sedimentation and their relationship to paleoclimates and ocean trends.

Courtnay Gerl, Holly Hill and Nathaniel Cameron

Abstract: Foraminifera distributions are paleontological indicators that accurately identify regional climate changes. A single core from west of Carriacou was collected at a depth of 1065 meters and yielded a time frame of at least 75,000 years with two episodes of increasing/decreasing temperature and salinity. Three species were used to indicate these climate changes: *G. ruber* (white), *G. ruber* (red), *G. menardii*, and *G. bulliodes*. Although trends seen in these three species reflect a regional climate, a localized occurrence of ash is seen to affect populations of foraminifera and thereby provide evidence of localized environmental changes. The introduction of ash into the basin also affects the grain size distribution. The ash layer averaged 125 microns, was an un-sorted, less mature mix of the sediment compared to the remainder of the core.

Data Summary:

Changes in foraminifera distributions are indicative of regional climate changes. Increasing numbers of *G. ruber* (white) and decreasing numbers of *G. ruber* (red) indicate lower sea surface temperature and vice versa. Increased numbers of *G. bulliodes* indicate lower salinity (Sen Gupta 2002).

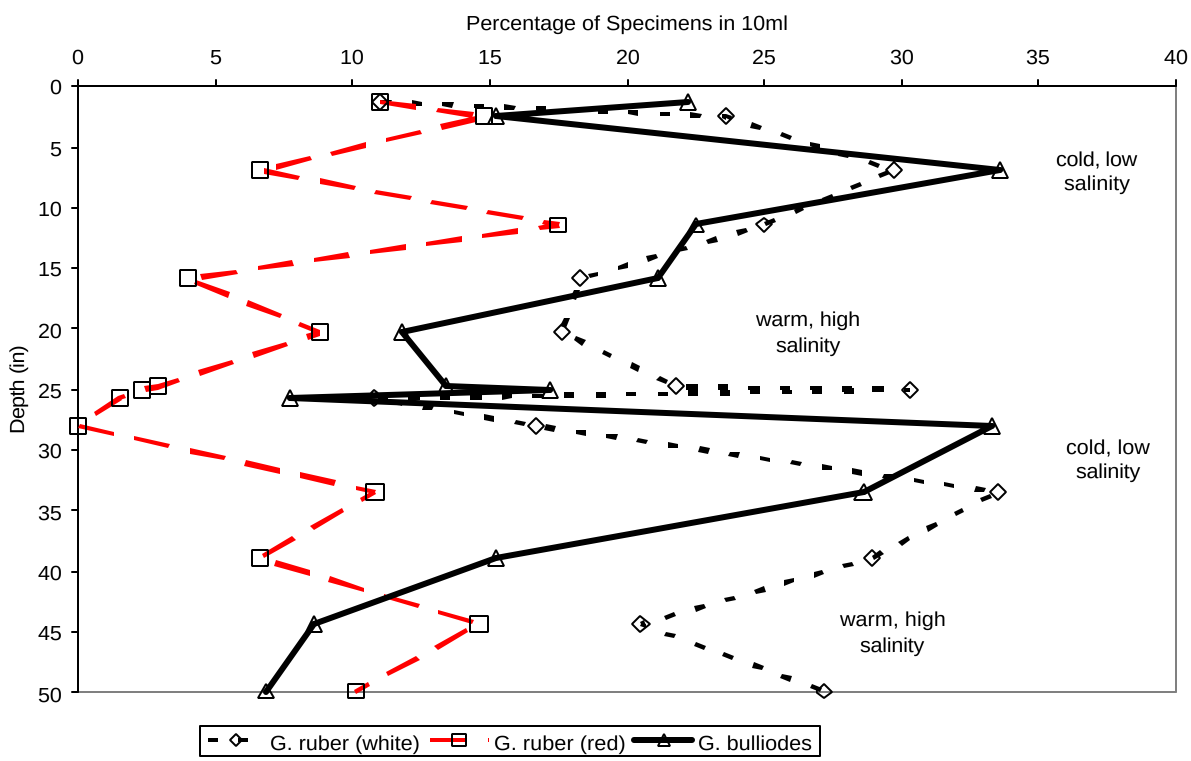


Figure 11. The percent composition of three species of foraminifera in 10 ml of sediment taken from different depths along a sediment core. Relative percent composition of these species indicate past sea surface conditions. Sen Gupta, Barun K., 2002, Modern Foraminifera Boston, Kluwer Academic Publishers.

The study of levels of pelagic tar, plastics and nutrient concentrations in the Caribbean waters with emphasis on the islands of Grenada, Jamaica, Guadeloupe and Carriacou

Brekke Holub and Ben Tipton

Abstract: Pelagic tar, plastics and nutrients were studied throughout the Caribbean on the Corwith Cramer cruise track C190 from November 29, 2003 – January 8, 2004. Pelagic tar and plastics samples were collected using a neuston net deployed approximately every twelve hours. Near shore waters were defined by their island wake effect determined from ADCP data and were compared to offshore waters. The data collected shows that more plastics and tar were found near shore in the island wake off Guadeloupe and convergent zones southeast of Jamaica with the exception of plastic pellets which were more abundant offshore. Nutrient concentrations (NO_3, PO_4) were analyzed using a sea water flow through system and were collected during every neuston tow. Higher amounts of phosphate were found near shore and higher amounts of nitrate were found offshore.

Data Summary:

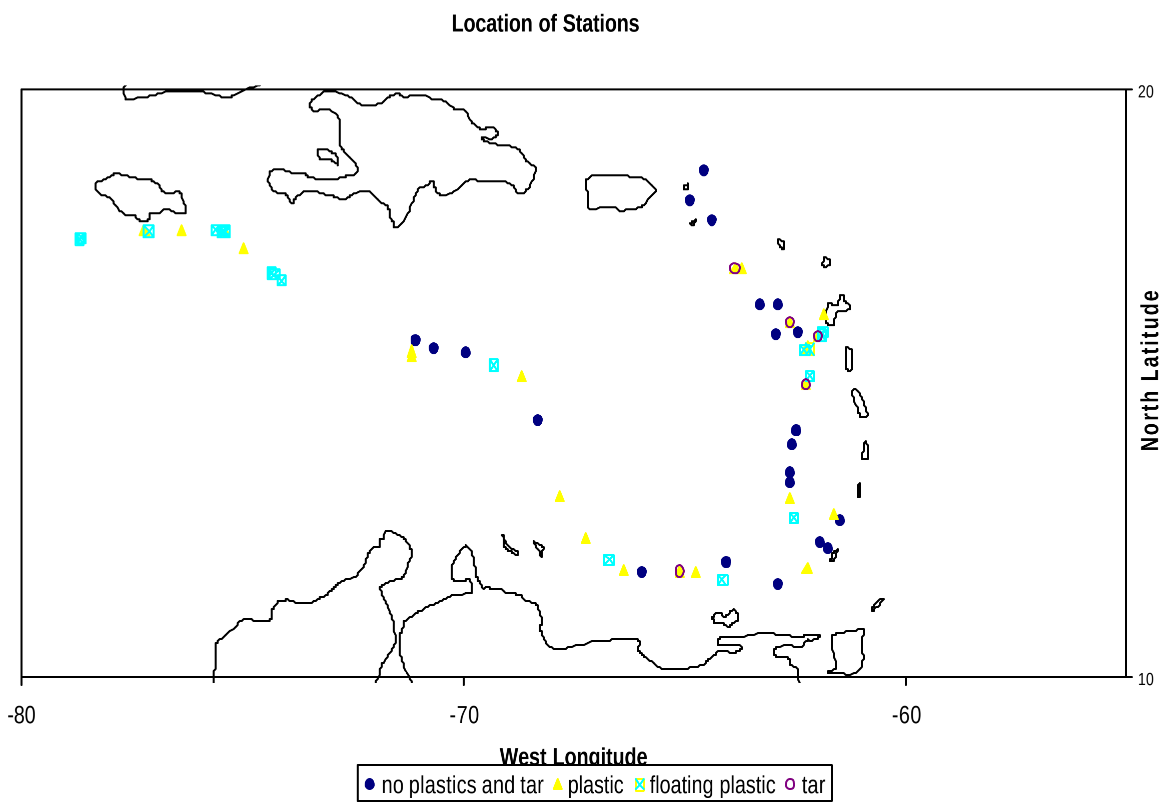


Figure 12. Neuston tow stations were used to collect surface plastic and tar pollutants. Stations that collected no tar or plastic pollutants are denoted with blue circles. Stations that collected plastic pollutants are denoted with yellow triangles. Stations that collected tar are denoted with open diamonds. Observations from the deck of floating plastic debris are denoted with a light blue 'x'.

Appendix A: Station summary information for C-190.

Station	Date ('03-'04)	Time (local)	Log (nm)	Lat (Deg N)	Lon (Deg W)	General Location	Station Type
C190-001	29-Nov	10:50	0.0	17.8	-64.7	E Gallows Bay, St Croix	AT
C190-002	29-Nov	12:10	0.0	17.7	-64.7	Protestant Cay, St Croix	AT
C190-003	30-Nov	18:50	17.2	17.8	-64.6	Buck Island, St Croix	SG
C190-004	30-Nov	19:06	17.2	17.8	-64.6	Buck Island, St Croix	SG
C190-006	1-Dec	0:56	38.3	18.1	-64.9	N St Croix	NT
C190-007	1-Dec	11:59	80.0	18.6	-64.6	N St Croix	NT
C190-008	1-Dec	22:56	131.3	17.8	-64.4	NE St Croix	NT
C190-009	2-Dec	8:55	176.7	17.0	-63.9	W Saba Bank	HC/CTD/PN
C190-010	2-Dec	10:06	176.6	17.0	-63.9	W Saba Bank	NT
C190-011	2-Dec	16:20	199.0	17.4	-64.1	SW of Saba Bank	DN
C190-012	2-Dec	22:52	222.5	17.0	-63.7	S Saba Bank	NT
C190-013	3-Dec	10:11	269.3	16.3	-63.3	SW Saba bank	NT
C190-013	3-Dec	10:11	269.5	16.3	-63.3	SW Saba bank	MN
C190-013	3-Dec	9:11	269.3	16.3	-63.3	SW Saba Bank	HC/CTD/PN
C190-014	3-Dec	22:43	321.0	15.8	-62.9	W Guadeloupe	NT
C190-015	4-Dec	10:39	368.9	16.3	-62.9	W Guadeloupe	NT
C190-015	4-Dec	9:27	368.9	16.4	-62.9	W Guadeloupe	HC/CTD/PN
C190-016	4-Dec	23:55	417.0	16.1	-62.6	W Guadeloupe	NT
C190-017	5-Dec	10:38	462.0	15.9	-62.4	SW Guadeloupe	NT
C190-017	5-Dec	9:40	461.6	15.9	-62.4	SW Guadeloupe	HC/CTD/PN
C190-018	5-Dec	23:11	490.0	15.6	-62.3	W Dominica	NT
C190-019	6-Dec	12:05	530.6	15.6	-62.2	W Dominica Passage	NT
C190-019	6-Dec	12:45	532.5	15.6	-62.3	W Dominica Passage	DN
C190-019	6-Dec	11:35	530.2	15.6	-62.2	W Dominica Passage	MN
C190-019	6-Dec	10:30	530.2	15.6	-62.2	W Dominica Passage	HC/CTD/PN
C190-020	6-Dec	23:29	571.8	16.2	-61.8	W Guadeloupe	SG
C190-021	6-Dec	0:12	573.4	16.2	-61.8	W Guadeloupe	SG
C190-022	6-Dec	0:34	573.5	16.2	-61.8	W Guadeloupe	SG
C190-023	6-Dec	0:52	573.5	16.2	-61.8	W Guadeloupe	SG
C190-024	6-Dec	0503	575.6	16.24	-61.87	W Guadeloupe	SG
C190-025	7-Dec	6:46	578.3	16.2	-61.9	W Guadeloupe	NT
C190-025	7-Dec	6:46	578.3	16.2	-61.9	W Guadeloupe	DN
C190-026a	7-Dec	14:12	597.0	15.8	-62.0	SW Guadeloupe	NT
C190-026b	8-Dec	9:35	675.9	15.0	-62.2	SW Dominica	HC/CTD/PN
C190-026b	8-Dec	11:32	676.0	15.0	-62.3	SW Dominica	NT
C190-027	9-Dec	0:55	723.5	14.2	-62.5	W Dominica	NT
C190-028	9-Dec	8:32	749.5	14.0	-62.5	W St Lucia Passage	HC/CTD/PN
C190-028	9-Dec	9:38	740.0	14.0	-62.5	W St Lucia Passage	MN
C190-028	9-Dec	10:07	741.1	14.0	-62.6	W St Lucia Passage	NT
C190-029	9-Dec	13:22	749.0	13.9	-62.6	W St Lucia Passage	PN
C190-030	9-Dec	22:19	777.8	13.5	-62.6	SW St. Lucia	NT
C190-030	9-Dec	20:05	764.5	13.6	-62.7	SW St. Lucia	TT
C190-031	10-Dec	2:05	778.1	13.3	-62.6	SW St Lucia	NT
C190-031	10-Dec	0:08	774.9	13.4	-62.6	SW St. Lucia	TT
C190-032	10-Dec	7:13	789.9	13.1	-62.6	SW St. Lucia	NT
C190-032	10-Dec	5:20	788.1	13.1	-62.6	SW St. Lucia	TT
C190-033	11-Dec	15:32	951.2	12.5	-61.5	W Carriacou	SG
C190-034	11-Dec	16:04	951.8	12.4	-62.5	W Carriacou	SG

Station	Date ('03-'04)	Time (local)	Log (nm)	Lat (Deg N)	Lon (Deg W)	General Location	Station Type
C190-035	11-Dec	16:33	952.1	12.4	-61.6	W Carriacou	SG
C190-036	11-Dec	17:10	952.1	12.5	-61.5	W Carriacou	GC
C190-037	15-Dec	13:46	1003.4	12.7	-61.5	W Mayreau	NT
C190-038	15-Dec	18:51	1022.5	12.6	-61.4	W Mayreau	SG
C190-039	15-Dec	20:05	1025.1	12.6	-61.4	W Mayreau	SG
C190-040	15-Dec	20:54	1026.0	12.6	-61.5	W Mayreau	SG
C190-041	16-Dec	0:12	1042.3	12.8	-61.6	W Mayreau	NT
C190-042A	14-Dec	11:14	991.7	12.5	-61.5	Sandy Island, Carriacou	AT
C190-042B	14-Dec	13:00	991.7	12.5	-61.5	Hillsborough, Carriacou	AT
C190-042C	14-Dec	13:30	991.7	12.6	-61.5	W shore, Carriacou	AT
C190-043	16-Dec	17:28	1115.8	12.2	-61.8	W Grenada	NT
C190-044	17-Dec	0:35	1145.5	12.3	-61.9	W Grenada	NT
C190-045	17-Dec	10:04	1171.5	11.9	-62.2	W Grenada Passage	NT
C190-045	17-Dec	9:03	1171.5	11.9	-62.2	W Grenada Passage	MN
C190-045	17-Dec	7:30	1171.1	11.9	-62.2	W Grenada Passage	HC/CTD/PN
C190-046	17-Dec	17:35	1201.4	11.6	-62.9	SW Grenada	NT
C190-047	17-Dec	20:52	1204.0	11.6	-63.1	NW Los Testigos	SG
C190-048	17-Dec	22:12	1206.0	11.6	-63.2	NW Los Testigos	SG
C190-049	17-Dec	23:59	1209.4	11.5	-63.2	NW of Los Testigos	SG
C190-050	18-Dec	9:33	1253.7	12.0	-64.1	E Isles Los Hermanos	NT
C190-051	19-Dec	0:31	1324.0	11.8	-64.8	SW La Blanquilla	NT
C190-052	19-Dec	9:33	1349.4	11.8	-65.1	NW La Blanquilla	NT
C190-052	19-Dec	8:30	1349.3	11.8	-65.1	NW La Blanquilla	HC/CTD/PN
C190-053	19-Dec	23:49	1429.1	11.8	-66.0	E Isla La Orchilla	NT
C190-054	20-Dec	6:34	1465.4	11.8	-66.4	W Cayo Grande	NT
C190-055	20-Dec	12:24	1496.8	12.0	-66.7	NW Islas Los Roques	SG
C190-056	20-Dec	13:57	1501.2	12.0	-66.8	NW Islas Los Roques	SG
C190-057	20-Dec	14:48	1502.2	12.0	-66.8	NW Islas Los Roques	SG
C190-058	20-Dec	17:04	1511.7	12.1	-67.0	NW Islas Los Roques	SG
C190-059	21-Dec	0:26	1547.4	12.4	-67.3	NW Islas Los Roques	NT
C190-060	21-Dec	10:47	1594.5	13.1	-67.8	N Islas de Aves	NT
C190-060	21-Dec	10:24	1594.0	13.1	-67.8	N Islas de Aves	MN
C190-060	21-Dec	8:30	1593.5	13.1	-67.8	N Islas de Aves	HC/CTD/PN
C190-061	22-Dec	0:30	1670.9	14.4	-68.3	Central Caribbean	NT
C190-062	22-Dec	9:15	1717.9	15.1	-68.7	Central Caribbean	NT
C190-062	22-Dec	8:21	1717.5	15.1	-68.7	Central Caribbean	HC/CTD/PN
C190-063	23-Dec	0:03	1792.7	15.5	-70.0	Central Caribbean	NT
C190-064	23-Dec	12:50	1832.4	15.6	-70.7	Central Caribbean	NT
C190-064	23-Dec	12:13	1831.8	15.6	-70.7	Central Carribean	MN
C190-064	23-Dec	8:38	1830.6	15.7	-70.6	Central Caribbean	HC/CTD/PN
C190-065	23-Dec	20:04	1856.3	15.7	-71.1	Central Caribbean	NT
C190-065	23-Dec	20:04	1856.3	15.7	-71.1	Central Caribbean	TT
C190-066	24-Dec	2:20	1864.9	15.6	-71.2	Central Caribbean	NT
C190-066	23-Dec	23:58	1861.9	15.6	-71.1	Central Caribbean	TT
C190-067	24-Dec	5:42	1867.9	15.5	-71.2	Central Caribbean	NT
C190-067	24-Dec	3:42	1865.9	15.5	-71.2	Central Caribbean	TT
C190-068	25-Dec	8:00	2002.6	16.5	-73.6	Central Caribbean	DN
C190-069	26-Dec	0:04	2084.8	17.3	-75.0	S Jamaica Channel	NT
C190-070	26-Dec	10:59		17.6	-75.4	S Jamaica Channel	NT
C190-070	26-Dec	10:30	2120.2	17.6	-75.4	S Jamaica Channel	MN

Station	Date ('03-'04)	Time (local)	Log (nm)	Lat (Deg N)	Lon (Deg W)	General Location	Station Type
C190-070	26-Dec	8:42	2120.0	17.6	-75.4	S Jamaica Channel	HC/CTD/PN
C190-071	27-Dec	0:57	2167.2	17.6	-76.4	S Jamaica	NT
C190-072	27-Dec	8:32	2207.0	17.7	-77.0	S Jamaica	SG
C190-073	27-Dec	9:00	2219.6	17.6	-77.1	S Jamaica	DN
C190-074	27-Dec	11:36	2230.4	17.6	-77.2	S Jamaica	SG
C190-075	27-Dec	0:00	2231.0	17.6	-77.2	S Jamaica	NT
C190-076	27-Dec	14:23	2247.7	17.7	-77.5	S Jamaica	SG
C190-077	27-Dec	15:40	2250.4	17.7	-77.5	S Jamaica	DN
C190-078	28-Dec	0:42	2302.7	17.5	-78.2	W Jamaica	NT
C190-079	28-Dec	8:02	2330.5	17.5	-78.7	E Pedro Bank	SG
C190-080	28-Dec	9:59	2388.4	17.5	-78.5	Pedro Bank	DN
C190-081	28-Dec	9:59	2338.0	17.4	-78.8	Pedro Bank	SG
C190-082	28-Dec	12:04	2348.7	17.4	-79.0	W Pedro Bank	SG
C190-083	28-Dec	13:37	2356.4	17.5	-79.1	W Pedro Bank	NT
C190-084	29-Dec	22:30	2552.8	19.0	-81.5	Cayman Trench	2-MN
C190-085	2-Jan	9:23	3007.4	24.5	-84.6	Gulf of Mexico	Styrocast
C190-086	5-Jan	9:19	3268.6	24.4	-82.2	S Marquesas Keys	NT
C190-086	6-Jan	10:19	3268.6	24.4	-82.2	S Marquesas Keys	CTD
C190-087	5-Jan	11:30	3275.9	24.4	-82.2	S Marquesas Keys	DN
C190-088	5-Jan	14:11	3239.0	24.2	-82.2	SW Marquesas Keys	CTD
C190-089	5-Jan	17:20	3293.5	24.4	-82.1	SW Marquesas Keys	DN
C190-090	5-Jan	19:06	3297.8	24.4	-82.0	SW Boca Grande Key	NT
C190-090	5-Jan	18:12	3296.1	24.2	-81.9	SW Boca Grande Key	CTD
C190-091	5-Jan	22:49	3306.9	24.2	-81.9	SW Key West	CTD

Duplicate station numbers refer to different oceanographic equipment that was either deployed concurrently in the same location or was deployed sequentially in the same General Location but different latitude and longitude. Lettered entries refer different geographic locations around Carriacou. Abbreviations: N – north, S – south, W – west, E – east, SW – southwest, NW – northwest, NE – northeast, NT – neuston tow, PN – phytoplankton net, MN – meter net (either 1 or 2 m diameter), TT – tucker trawl, DN – dip net, CTD – conductivity, temperature and depth profiler, HC – hydrocast with 12 niskin bottles, SG – shipek grab and GC – gravity core.

Appendix B: Hydrocast data for C-190.

Station	Date ('03-'04)	Time (local)	Lat. (deg. N)	Lon. (deg. W)	General Location	Bottle No.	Depth (m)	O_2 (mg/l)	PO_4 (μM)	Chl a (μg/l)
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	1	398	3.35	1.745	0.001
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	2	298	4.53	2.049	0.002
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	3	199	4.50	0.306	0.002
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	4	149	4.45	0.000	0.005
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	5	124	4.87	0.249	0.016
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	6	100	5.30	6.155	0.025
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	7	89	4.78	0.000	0.046
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	8	80	4.90	0.034	0.040
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	9	70		0.048	0.047
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	10	60	4.14	0.000	0.062
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	11	40	4.58	0.145	0.030
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	12	20	5.09	0.034	0.033
C190-013	3-Dec	8:55	16.26	-63.29	W Saba Bank	1	397	2.36	1.531	
C190-013	3-Dec	8:55	16.26	-63.29	W Saba Bank	2	298	2.90	0.693	0.002
C190-013	3-Dec	8:55	16.26	-63.29	W Saba Bank	3	149	3.91	0.000	0.002
C190-013	3-Dec	8:55	16.26	-63.29	W Saba Bank	4	74	4.66	0.000	0.048
C190-013	3-Dec	8:55	16.26	-63.29	W Saba Bank	5	50	4.47	0.000	0.020
C190-013	3-Dec	8:55	16.26	-63.29	W Saba Bank	6	26	4.43	0.000	0.014
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	1				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	2				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	3				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	4				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	5				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	6				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	7				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	8				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	9				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	10				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	11				
C190-015	4-Dec	9:27	16.36	-62.89	W Guadeloupe	12				
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	1	398	3.25	1.182	0.005
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	2	298	2.33	0.404	0.004
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	3	198	2.01	0.000	0.005

Station	Date ('03-'04)	Time (local)	Lat. (deg. N)	Lon. (deg. W)	General Location	Bottle No.	Depth (m)	O_2 (mg/l)	PO_4 (µM)	Chl a (µg/l)
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	4	99	2.93	0.000	0.046
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	5	90	2.76	0.000	0.063
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	6	79	2.62	0.000	0.173
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	7	69	2.78	0.000	0.308
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	8	60	3.73	0.000	0.187
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	9	49	4.36	0.000	0.088
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	10	40	4.77	0.000	0.028
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	11	29	3.34	0.000	0.039
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	12	21	2.57	0.000	0.077
C190-019	6-Dec	10:14	15.62	-62.18	W Dominica Passage	1	400	3.30	1.123	0.004
C190-019	6-Dec	10:14	15.62	-62.18	W Dominica Passage	2	300	3.86	0.167	0.003
C190-019	6-Dec	10:14	15.62	-62.18	W Dominica Passage	3	150	4.01	0.000	0.014
C190-019	6-Dec	10:14	15.62	-62.18	W Dominica Passage	4	75	4.27	0.000	0.006
C190-019	6-Dec	10:14	15.62	-62.18	W Dominica Passage	5	50	3.98	0.000	0.001
C190-019	6-Dec	10:14	15.62	-62.18	W Dominica Passage	6	25	4.60	0.000	-0.008
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	1	397	3.07	1.612	0.002
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	2	298	3.31	1.116	0.002
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	3	199	3.63	0.441	0.004
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	4	149	3.59	0.000	0.009
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	5	124	4.40	0.000	0.014
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	6	99	4.60	0.000	0.005
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	7	89	4.77	0.011	0.098
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	8	80	4.74	0.026	0.229
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	9	69	4.67	0.000	0.309
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	10	60	4.86	0.019	0.105
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	11	40	4.71	0.000	0.016
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	12	20	4.69	0.000	0.035
C190-028	9-Dec	8:32	13.97	-62.51	W St Lucia Passage	1	397	3.11	0.789	0.002
C190-028	9-Dec	8:32	13.97	-62.51	W St Lucia Passage	2	298	3.39	1.745	0.003
C190-028	9-Dec	8:32	13.97	-62.51	W St Lucia Passage	3	149	3.95	0.000	0.008
C190-028	9-Dec	8:32	13.97	-62.51	W St Lucia Passage	4	75	4.50	0.048	0.177
C190-028	9-Dec	8:32	13.97	-62.51	W St Lucia Passage	5	50	4.56	0.000	0.424
C190-028	9-Dec	8:32	13.97	-62.51	W St Lucia Passage	6	25	4.68	0.255	0.187
C190-045	17-Dec	7:35	11.88	-62.24	W Grenada Passage	1	186	3.59	1.041	0.090
C190-045	17-Dec	7:35	11.88	-62.24	W Grenada Passage	2	186	3.98	1.032	0.004
C190-045	17-Dec	7:35	11.88	-62.24	W Grenada Passage	3	149	3.96	0.711	0.005

Station	Date ('03-'04)	Time (local)	Lat. (deg. N)	Lon. (deg. W)	General Location	Bottle No.	Depth (m)	O_2 (mg/l)	PO_4 (µM)	Chl a (µg/l)
C190-045	17-Dec	7:35	11.88	-62.24	W Grenada Passage	4	75	3.98	1.209	0.108
C190-045	17-Dec	7:35	11.88	-62.24	W Grenada Passage	5	50	4.96	0.613	0.221
C190-045	17-Dec	7:35	11.88	-62.24	W Grenada Passage	6	25	4.96		0.215
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	1	398	3.31	0.356	0.008
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	2	298	3.44	0.302	0.002
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	3	199	3.25	0.160	0.006
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	4	150	3.82	0.270	0.005
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	5	124	3.75	0.247	0.007
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	6	99	3.82	0.153	0.035
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	7	90	4.01	0.892	0.024
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	8	80	4.16	1.013	0.016
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	9	70	4.64	0.981	0.102
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	10	59	4.31	0.888	0.182
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	11	39	5.17	0.944	0.125
C190-052	19-Dec	8:30	11.82	-65.12	NW La Blanquilla	12	21	5.27	0.795	0.135
C190-060	21-Dec	8:30	13.08	-67.79	N Islas de Aves	1		3.32		0.004
C190-060	21-Dec	8:30	13.08	-67.79	N Islas de Aves	2		3.56	1.032	0.004
C190-060	21-Dec	8:30	13.08	-67.79	N Islas de Aves	3		4.12	0.906	0.006
C190-060	21-Dec	8:30	13.08	-67.79	N Islas de Aves	4		4.80	0.776	0.151
C190-060	21-Dec	8:30	13.08	-67.79	N Islas de Aves	5		5.14	0.594	0.005
C190-060	21-Dec	8:30	13.08	-67.79	N Islas de Aves	6		4.99		0.133
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	1	398	3.54	1.535	0.002
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	2	298	3.96	1.596	0.000
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	3	199	4.02	0.646	0.000
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	4	150	4.22	0.566	0.016
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	5	125	4.30	1.255	0.042
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	6	100	4.58	0.767	0.022
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	7	89	4.81	1.074	0.112
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	8	80	4.68	0.389	0.252
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	9	69	4.85	0.459	0.221
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	10	60	5.00	0.343	0.285
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	11	40	4.97	0.469	0.033
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	12	20	4.85	0.385	0.094
C190-064	23-Dec	8:38	15.67	-70.62	Central Caribbean	1	467	3.56		
C190-064	23-Dec	8:38	15.67	-70.62	Central Caribbean	2	368	3.96	1.563	0.001
C190-064	23-Dec	8:38	15.67	-70.62	Central Caribbean	3	227	4.45	0.552	0.035

Station	Date ('03-'04)	Time (local)	Lat. (deg. N)	Lon. (deg. W)	General Location	Bottle No.	Depth (m)	O_2 (mg/l)	PO_4 (µM)	Chl a (µg/l)
C190-064	23-Dec	8:38	15.67	-70.62	Central Caribbean	4	168	4.68	0.455	0.063
C190-064	23-Dec	8:38	15.67	-70.62	Central Caribbean	5	150	5.89	0.627	0.057
C190-064	23-Dec	8:38	15.67	-70.62	Central Caribbean	6	129	5.00		0.120
C190-070	26-Dec	8:42	17.61	-75.42	S Jamaica Channel	1	397	4.15		
C190-070	26-Dec	8:42	17.61	-75.42	S Jamaica Channel	2	298	4.17	1.842	0.000
C190-070	26-Dec	8:42	17.61	-75.42	S Jamaica Channel	3	149	4.47	0.878	0.009
C190-070	26-Dec	8:42	17.61	-75.42	S Jamaica Channel	4	75	5.38	0.552	0.125
C190-070	26-Dec	8:42	17.61	-75.42	S Jamaica Channel	5	50	5.00	0.077	0.114
C190-070	26-Dec	8:42	17.61	-75.42	S Jamaica Channel	6	26	5.09		0.139

Water samples were collected in 2.5 liter Niskin bottles deployed on a self-contained carousel system with a SBE019Plus CTD sensor (Seabird Instruments, Inc.). Dissolved oxygen (O_2) concentrations were determined chemically by Winkler titration. Phosphate (PO_4) levels were measured by colorimetric analysis with an Ocean Optics Chem2000 digital spectrophotometer and chlorophyll-a (Chl-a) concentrations were determined with a Turner Designs Model 10-AU Fluorometer following methods outlined in Parsons, Maita and Lalli (1984; *A Manual of Chemical and Biological Methods for Seawater Analysis*, Pergomon Press). Blank indicates that an analysis was not performed for that sample.

Appendix C: Neuston data for C-190.

Station (C-190)	Date ('03-'04)	Time (local)	Lat. (deg N)	Long. (deg W)	General Location	Dist (m)	Zpl Bio (ml)	*Sar _flu (g)*	*Sar _nat (g)*	Phy (#)	Myc (#)	Hal (#)	Lep (#)	Plas _pel (#)	Plas _pcs (#)	Tar
006	1-Dec	0:56	18.12	-64.89	N St. Croix	1852	33	0	0	3	17	4	0	0	0	No
007	1-Dec	11:59	18.64	-64.56	N St. Croix	1852	2	0	0	0	1	0	0	0	1	No
008	1-Dec	22:56	17.79	-64.39	NE of St. Croix	1852	19	90	10	0	8	5	0	0	0	No
010	2-Dec	10:06	16.97	-63.87	W Saba Bank	1667	4	0	0	0	0	1	0	5	0	Yes
012	2-Dec	22:52	16.98	-63.70	S Saba Bank	1852	12	28	0	0	1	4	0	0	3	No
013	3-Dec	10:11	16.35	-63.31	SW Saba Bank	1852	9	0	0	0	0	0	0	0	0	No
014	3-Dec	22:43	15.84	-62.94	W Guadeloupe	1852	8	0	0	0	4	13	0	0	0	No
015	4-Dec	10:39	16.34	-62.91	W Guadeloupe	1667	6	0	0	0	0	2	0	0	0	No
016	4-Dec	23:55	16.06	-62.62	W Guadeloupe	1852	12	0	0	0	1	22	0	0	0	Yes
017	5-Dec	10:38	15.88	-62.45	SW Guadeloupe	1852	10	0	0	0	0	2	0	0	0	No
018	5-Dec	23:11	15.60	-62.27	W Dominica	1482	6	0	0	0	0	0	1	1	3	No
019	6-Dec	12:05	15.62	-62.20	W Dominica Passage	5926	5	0	0	0	0	2	0	0	1	No
025	7-Dec	6:46	16.19	-61.86	W Guadeloupe	1667	10	25	10	0	0	7	0	0	4	No
026a	7-Dec	14:12	15.81	-61.99	SW Guadeloupe	2778	6	0	0	0	22	10	0	0	4	Yes
026b	8-Dec	11:32	14.99	-62.27	SW Dominica	1852	1	0	0	0	0	0	0	0	1	Yes
027	9-Dec	0:55	14.21	-62.47	W Dominica	1667	69	0	0	0	0	14	0	0	0	No
028	9-Dec	10:07	13.97	-62.58	W St. Lucia Passage	1852		0	0	0	0	2	0	0	0	No
030	9-Dec	22:19	13.50	-62.64	SW St. Lucia	1296	21	0	0	0	3	0	1	0	0	No
031	10-Dec	2:05	13.32	-62.64	SW St Lucia	1667	60	0	0	0	1	7	0	0	0	No
032	10-Dec	7:13	13.06	-62.64	SW St. Lucia	926	21	0	0	0	0	1	0	0	2	No
037	15-Dec	13:46	12.67	-61.50	W Mayreau	1852	6	10	0	0	0	4	3	0	0	No
041	16-Dec	0:12	12.77	-61.62	W Mayreau	600	27	0	0	0	3	9	3	0	2	No
043	16-Dec	17:28	12.20	-61.78	W Grenada	1852	10	0	0	0	0	12	0	0	0	No
044	17-Dec	0:35	12.31	-61.93	W Grenada	2037	23	0	0	0	10	14	8	0	0	No
045	17-Dec	10:04	11.88	-62.24	W Grenada Passage	1296	18	0	0	0	0	77	0	0	1	No
046	17-Dec	17:35	11.60	-62.91	SW Grenada	1852	38	0	0	0	0	1	0	0	0	No
050	18-Dec	9:33	11.98	-64.05	E Isles Los Hermanos	926	21	0	0	0	0	0	0	0	0	No
051	19-Dec	0:31	11.80	-64.76	SW La Blanquilla	1324	84	0	0	0	2	1	0	0	2	No
052	19-Dec	9:33	11.82	-65.13	NW La Blanquilla	1482	6	0	0	0	1	1	0	0	0	Yes
053	19-Dec	23:49	11.81	-65.99	E Isla La Orchilla	1667	34	0	0	0	8	2	0	0	0	No
054	20-Dec	6:34	11.82	-66.38	W Cayo Grande	1852	7	10	0	0	0	0	0	0	1	No

Station (C-190)	Date ('03-'04)	Time (local)	Lat. (deg N)	Long. (deg W)	General Location	Dist (m)	Zpl Bio (ml)	*Sar _flu (g)*	*Sar _nat (g)*	Phy (#)	Myc (#)	Hal (#)	Lep (#)	Plas _pel (#)	Plas _pcs (#)	Tar
059	21-Dec	0:26	12.37	-67.26	NW Islas Los Roques	1852	71	<10	0	1	0	1	2	5	5	No
060	21-Dec	10:47	13.08	-67.85	N Islas de Aves	741	12	0	0	0	0	0	0	0	4	No
061	22-Dec	0:30	14.39	-68.33	Central Caribbean	1852	19	0	0	1	5	6	8	0	0	No
062	22-Dec	9:15	15.12	-68.68	Central Caribbean	1945	3	0	0	0	0	3	0	0	2	No
064	23-Dec	12:50	15.61	-70.69	Central Caribbean	1811	36	<10	0	0	0	0	0	0	0	No
063	23-Dec	0:03	15.53	-69.95	Central Caribbean	2222	16	0	0	0	9	8	0	0	0	No
065	23-Dec	20:04	15.74	-71.11	Central Caribbean	3334	11	0	0	2	3	29	0	0	0	No
066	24-Dec	2:20	15.55	-71.17	Central Caribbean	1852	16	0	0	0	2	11	0	3	1	No
067	24-Dec	5:42	15.47	-71.20	Central Caribbean	1296	4	0	0	0	1	2	0	5	1	No
069	26-Dec	0:04	17.30	-74.98	S Jamaica Channel	1296	12	0	0	0	3	18	1	0	1	No
070	26-Dec	10:59	17.58	-75.42	S Jamaica Channel	2130	62	0	0	0	0	0	0	0	1	No
071	27-Dec	0:57	17.61	-76.39	S Jamaica	1296	8	10	<10	33	20	2	0	0	47	No
075	27-Dec	12:00	17.60	-77.23	S Jamaica	1852	3	<10	0	1	0	0	0	0	2	No
078	28-Dec	0:40	17.52	-78.16	W Jamaica	1111	18	<10	<10	0	1	0	1	2	0	No
083	28-Dec	13:33	17.46	-79.08	W Pedro Bank	2037	3	<10	0	0	3	0	0	0	1	No
086	5-Jan	9:19	24.41	-82.21	S Marquesas Keys	2315	10	<10	0	0	0	0	0	0	0	No
090	5-Jan	19:06	24.39	-82.04	SW Boca Grande Key	1852	13	2	3	0	0	0	0	0	0	No

Tow distance (Dist) was determined by taffrail log. Net opening was 1.0 m wide by 0.5 m tall with a net mesh of 333 um. Zooplankton biomass (Zpl) is recorded as wet volume (ml) displacement. *Sargassum fluitans* (*Sar_flu*) and *S. natans* (*Sar_nat*) is recorded as wet weight (g) using a spring scale. Counts of phyllosoma (Phy), leptocephali (Lep), *Halobates micans* (*Hal*) and myctophids (Myc) refer to numbers caught in a each net tow. Plastics collected in each net tow were separated as pieces (pcs) and pellets (pts) and enumerated. Presence or absence of tar in each net tow is also indicated.

Appendix D: Tucker Trawl and Meter Net data for C-190.

Station (C-190)	Date ('03-'04)	Time (local)	Lat. (deg N)	Long. (deg W)	Net	General Location	Net Depth (m)	Zpl Bio (ml)	Tow Dist (m)	Zpl Den (ml/m^3)
013-MN1	3-Dec	10:11	16.26	-63.29	1-meter	SW Saba bank	300	87	5180	0.021
013-MN2	3-Dec	10:23	16.26	-63.29	1-meter	SW Saba bank	150	38	2943	0.016
013-MN3	3-Dec	10:30	16.26	-63.29	1-meter	SW Saba bank	75	83	2187	0.048
019-MN1	6-Dec	11:35	15.62	-62.20	1-meter	W Dominica Passage	300	75	3889	0.024
019-MN2	6-Dec	11:37	15.62	-62.20	1-meter	W Dominica Passage	150	82	2222	0.047
019-MN3	6-Dec	11:55	15.62	-62.20	1-meter	W Dominica Passage	75	180	2135	0.011
028-MN1	9-Dec	9:38	13.97	-62.55	1-meter	W St. Lucia Passage	300	112	5669	0.025
028-MN2	9-Dec	9:51	13.97	-62.55	1-meter	W St. Lucia Passage	150		2883	
028-MN3	9-Dec	9:51	13.97	-62.55	1-meter	W St. Lucia Passage	75		1049	
030-TT1	9-Dec	20:05	13.56	-62.65	tucker	SW St Lucia	650-400	26	3334	0.008
030-TT2	9-Dec	21:32	13.56	-62.65	tucker	SW St Lucia	400-150	133	1667	0.080
030-TT3	9-Dec	22:00	13.56	-62.65	tucker	SW St Lucia	150-25	3	2963	0.001
031-TT1	10-Dec	0:08	13.39	-62.61	tucker	SW St Lucia	650-400	36	3519	0.010
031-TT2	10-Dec	1:18	13.39	-62.61	tucker	SW St Lucia	400-150	355	1296	0.270
031-TT3	10-Dec	1:49	13.39	-62.61	tucker	SW St Lucia	150-25	29	3519	0.008
032-TT1	10-Dec	5:20	13.13	-62.61	tucker	SW St Lucia	650-400	43	1067	0.025
032-TT2	10-Dec	6:28	13.13	-62.61	tucker	SW St Lucia	400-150	12	1296	0.009
032-TT3	10-Dec	7:01	13.13	-62.61	tucker	SW St Lucia	150-25	71	2593	0.027
045-MN1	17-Dec	9:03	11.88	-62.24	1-meter	W Grenada Passage	300	82	6559	0.016
045-MN2	17-Dec	9:18	11.88	-62.24	1-meter	W Grenada Passage	150	86	4441	0.025
045-MN3	17-Dec	9:28	11.88	-62.24	1-meter	W Grenada Passage	75	127	1659	0.098
060-MN1	21-Dec	10:24	13.08	-67.85	1-meter	N Islas de Aves	300		2557	
060-MN2	21-Dec	10:34	13.08	-67.85	1-meter	N Islas de Aves	150		2129	
060-MN3	21-Dec	10:41	13.08	-67.85	1-meter	N Islas de Aves	75		1643	
064-MN1	23-Dec	12:13	15.61	-70.69	1-meter	Central Carribean	300	63	4290	0.019
064-MN2	23-Dec	12:30	15.61	-70.69	1-meter	Central Carribean	150	40	2711	0.019
064-MN3	23-Dec	12:39	15.61	-70.69	1-meter	Central Carribean	75	53	1811	0.037
065-TT1	23-Dec	20:04	15.74	-71.12	tucker	Central Caribbean	650-400	17	2408	0.007
065-TT2	23-Dec	20:04	15.74	-71.12	tucker	Central Caribbean	400-150	91	4815	0.018
065-TT3	23-Dec	20:04	15.74	-71.12	tucker	Central Caribbean	150-25	3	3334	0.001
066-TT1	23-Dec	23:58	15.63	-71.15	tucker	Central Caribbean	650-400	40	3889	0.010
066-TT2	23-Dec	23:58	15.63	-71.15	tucker	Central Caribbean	400-150	60	926	0.064

066-TT3	23-Dec	23:58	15.63	-71.15	tucker	Central Caribbean	150-25	1	2222	0.004
067-TT1	24-Dec	3:42	15.52	-71.18	tucker	Central Caribbean	650-400	33	2408	0.013
067-TT2	24-Dec	3:42	15.52	-71.18	tucker	Central Caribbean	400-150	6	741	0.008
067-TT3	24-Dec	3:42	15.52	-71.18	tucker	Central Caribbean	150-25	3	2037	0.001

Numbered (1-3) nets refer to multiple nets towed concurrently at different depths. Tucker trawl nets had a 1.0 m^2 net opening assuming a constant tow angle when sailing at 2 knots. Meter nets (1.0 m diameter) had a 0.78 m^2 net opening. For station 065 TT2 did not close and TT3 did not open. Zooplankton biomass (Zpl Bio) is based on wet volume displacement. Zooplankton density (Zpl Den) is based on wet volume biomass and tow volume calculations based on net area (m^2) and distance the net was towed (Tow Dist in m).

Appendix E: Shipek Grab (SG) and Gravity Core (GC) data for C-190.

Station (C-190)	Date ('03-'04)	Time (local)	Lat. (deg N)	Long. (deg W)	General Location	Depth (m)	%2000 um	%1000 um	%500 um	%250 um	%125 um	%63 um	%<63 est	total %
003-SG	30-Nov	1850	17.81	-64.64	Buck Island, St Croix	78	11	18	24	4	6	7	30	100
004-SG	30-Nov	1906	17.80	-64.65	Buck Island, St Croix	375	1	1	2	4	8	24	61	100
020-SG	6-Dec	2329	16.19	-61.80	W Guadeloupe	56	23	2	9	7	10	28	21	100
021-SG	6-Dec	0012	16.21	-61.81	W Guadeloupe	53	28	22	45	6	4	4	0	109
022-SG	6-Dec	0034	16.21	-61.82	W Guadeloupe	210	2	3	12	2	2	4	25	50
023-SG	6-Dec	0052	16.21	-61.82	W Guadeloupe	269	5	9	49	17	9	5	6	100
024-SG	7-Dec	0503	16.24	-61.87	W Guadeloupe	460	50	20	10	10	5	5	0	100
033-SG	11-Dec	1532	12.46	-61.53	W Carriacou	13	50	5	21	10	12	5	0	103
034-SG	11-Dec	1604	12.44	-62.55	W Carriacou	122	8	8	8	8	16	4	46	100
035-SG	11-Dec	1633	12.44	-61.56	W Carriacou	360								
036-GC	11-Dec	17:10	12.5	-61.50	W Carriacou	1026								
038-SG	15-Dec	1851	12.64	-61.43	W Mayreau	63	40	9	25	2	2	1	22	100
039-SG	15-Dec	2005	12.61	-61.43	W Mayreau	77	0	1	1	1	61	4	33	100
040-SG	15-Dec	2054	12.58	-61.51	W Mayreau	326	5	4	14	8	18	18	33	100
047-SG	17-Dec	2052	11.59	-63.08	NW Los Testigos	156	17	33	44	17	2	17	0	127
048-SG	17-Dec	2212	11.58	-63.16	NW Los Testigos	96	9	18	18	18	36	0	0	100
049-SG	17-Dec	2359	11.54	-63.25	NW Los Testigos	70	9	20	35	9	4	3	20	100
055-SG	20-Dec	1224	11.97	-66.72	NW Islas Los Roques	38	40	15	32	10	3	3	0	103
056-SG	20-Dec	1357	12.00	-66.82	NW Islas Los Roques	97	4	20	60	5	4	6	1	100
057-SG	20-Dec	1448	12.03	-66.84	NW Islas Los Roques	205	5	9	44	6	3	8	25	100
058-SG	20-Dec	1704	12.13	-66.97	NW Islas Los Roques	300								
072-SG	27-Dec	0832	17.68	-76.97	S Jamaica	30	11	38	38	9	2	1	1	100
074-SG	27-Dec	1136	17.60	-77.22	S Jamaica	26	9	34	37	16	4	0	0	100
076-SG	27-Dec	1423	17.65	-77.47	S Jamaica	24	30	42	24	3	1	0	0	100
079-SG	28-Dec	0802	17.48	-78.66	E Pedro Bank	55	18	6	24	14	14	4	0	80
081-SG	28-Dec	0959	17.44	-78.79	Pedro Bank	23	32	18	29	16	5	2	0	102
082-SG	28-Dec	1204	17.43	-78.97	W Pedro Bank	35								

Appendix F: Dip Net data for C-190.

Station	Date (2002)	Time (local)	Lat. (deg N)	Long. (deg W)	General Location
C190-011	2-Dec	16:20	17.39	-64.10	SW Saba Bank
C190-019	6-Dec	12:45	15.60	-62.25	W Dominica Passage
C190-025	7-Dec	6:46	16.19	-61.86	W Guadeloupe
C190-068	25-Dec	8:00	16.48	-73.58	Central Caribbean
C190-073	27-Dec	9:00	17.61	-77.09	S Jamaica
C190-077	27-Dec	15:40	17.66	-77.48	S Jamaica
C190-080	28-Dec	0:00	17.47	-78.68	Pedro Bank
C190-087	5-Jan	11:30	24.36	-82.23	S Marquesas Keys
C190-089	5-Jan	17:20	24.38	-82.10	SW Marquesas Keys

Appendix G: Surface station data for C-190.

Station	Date ('03-'04)	Time (local)	Lat. (deg N)	Long. (deg W)	Temp (oC)	Sal (ppt)	PO4 (μM)	Chl-a (μg/l)	NO3 (μM)
SS-001	29-Nov	11:30	17.75	-64.70	28.5	34.7			
SS-002	29-Nov	12:45	17.75	-64.70	28.5	34.4			
SS-003	1-Dec	1:00	18.02	-64.77	28.2	34.7	0.249	0.046	5.421
SS-004	1-Dec	12:00	18.64	-64.59	28.2	34.7	0.063	0.038	5.150
SS-005	1-Dec	23:00	17.79	-64.39	28.4	35.2	10.498	0.200	4.336
SS-006	2-Dec	10:40	16.95	-63.89	28.3	34.7	0.019	0.064	4.065
SS-007	2-Dec	17:47	17.27	-63.91	28.3	34.7	0.827	0.034	4.336
SS-008	3-Dec	9:30	16.26	-63.29	28.1	34.8	0.915	0.014	3.793
SS-009	3-Dec	10:45	16.22	-63.29	28.1	34.8	0.011	0.035	3.793
SS-010	4-Dec	0:42	15.89	-62.96	28.2	34.8	0.234	0.030	4.607
SS-011	4-Dec	10:49	16.39	-63.01	28.1	34.5	0.000	0.063	4.879
SS-012	4-Dec	0:00	16.11	-62.76	28.2	34.7	0.471	0.000	7.320
SS-013	5-Dec	10:58	15.88	-62.45	28.4	34.2	0.115	0.156	2.708
SS-014	5-Dec	23:36	15.60	-62.27	28.6	34.9	0.063	0.057	6.289
SS-015	6-Dec	12:13	15.62	-62.22	28.6	34.9	0.048	0.054	5.421
SS-016	7-Dec	6:46	16.19	-61.86	28.5	34.3	0.071	0.168	4.879
SS-017	7-Dec	14:19	15.81	-61.91	28.8	35.0	0.000	0.063	4.336
SS-018	8-Dec	11:42	14.98	-62.27	28.7	35.1	0.000	0.048	4.879
SS-019	9-Dec	1:05	14.21	-62.47	28.3	35.4	0.108	0.120	5.964
SS-020	9-Dec	13:08	13.84	-62.66	28.4	35.5	0.000	0.294	4.607
SS-021	9-Dec	22:21	13.49	-62.69	28.3	35.2	0.204	0.296	3.522
SS-022	14-Dec						0.366		
SS-022	14-Dec	14:20	12.49	-61.48			0.580	0.391	3.137
SS-023	14-Dec	13:23	12.49	-61.48			0.380	0.117	1.015
SS-023	14-Dec	13:23	12.49	-61.48			0.408	0.140	
SS-024	14-Dec	14:00	12.48	-61.47			0.492	0.206	0.308
SS-024	14-Dec	14:00	12.48	-61.47			0.464	0.202	
SS-025	15-Dec	13:50	12.67	-61.49	28.3	35.6	0.534	0.085	
SS-026	16-Dec	0:25	12.76	-61.62	28.3	35.1	0.483		
SS-027	16-Dec	17:37	12.20	-61.78	28.4	35.2	0.804	0.072	0.779
SS-028	17-Dec	0:40	12.31	-61.93	28.2				
SS-029	17-Dec	10:00	11.88	-62.24	28.0		0.678	0.100	1.015
SS-030	17-Dec	17:45	11.60	-62.92	28.1	33.1	0.511	0.191	
SS-031	18-Dec	9:38	11.97	-64.06	28.0	35.2	0.869	0.059	
SS-031	18-Dec	9:38	11.97	-64.06	28.0	35.2	0.604	0.226	
SS-032	19-Dec	0:49	11.80	-64.77	27.0	36.4			
SS-033	19-Dec	9:39	11.82	-65.15	27.1	36.4	0.543	0.126	0.000
SS-034	20-Dec	6:39	11.82	-66.38	27.5	36.4	0.571	0.096	
SS-035	21-Dec	0:30	12.37	-67.26	27.6	36.3	0.650	0.144	
SS-036	21-Dec	8:30	13.08	-67.85			0.902	0.094	
SS-037	22-Dec	0:35	14.39	-68.33	28.0	36.0	0.511	0.039	0.000
SS-038	22-Dec	9:40	15.12	-68.68	28.1	36.2	0.604	0.053	1.251
SS-039	23-Dec	0:03	15.53	-69.95	27.9	35.1	0.487	0.063	
SS-040	23-Dec	13:02	15.67	-70.62	28.2	35.1	0.520	0.052	0.000
SS-041	23-Jan	22:20	15.67	-71.14	28.1	35.1	0.469	0.091	0.543
SS-042	24-Dec	2:32	15.55	-71.17	28.1	35.1	0.427	0.086	
SS-043	24-Dec	5:51	15.46	-71.21	28.0	35.2	0.669	0.087	
SS-044	25-Dec	9:33	16.48	-73.58	28.0	35.3	0.511	0.109	2.430

Station	Date ('03-'04)	Time (local)	Lat. (deg N)	Long. (deg W)	Temp (oC)	Sal (ppt)	PO4 (μM)	Chl-a (μg/l)	NO3 (μM)
SS-045	26-Dec	0:06	17.29	-74.97	27.8	35.0	0.757	0.124	2.665
SS-046	26-Dec	8:52	17.61	-75.42	27.7	35.5	0.478	0.041	0.072
SS-047	27-Dec	1:05	17.58	-77.18	27.8	35.5	0.506	0.053	0.308
SS-048	27-Dec	10:54	17.58	-77.18	28.1	35.5	0.590	0.056	2.779
SS-048	27-Dec	10:54	17.60	-77.24	28.1	35.5	0.473	0.054	
SS-049	27-Dec	12:11	17.66	-77.47	28.3	35.6	2.196	0.161	0.072
SS-050	27-Dec	15:32	17.66	-77.47	28.2	35.7	0.394	0.115	0.000
SS-050	27-Dec	15:32	17.66	-77.47	28.2	35.7	0.883	0.094	
SS-051	28-Dec	0:40	17.52	-78.16	28.2	35.6	0.455	0.084	0.000
SS-052	28-Dec	8:47	17.47	-78.69	27.9	35.5	0.403	0.116	1.015
SS-053	28-Dec	13:39	17.45	-79.08	28.8	35.5	0.483	0.182	0.000

Temperature and salinity were determined using a continuous salinity/temperature/fluorescence flow-thru data logger. Phosphate (PO_4) and nitrate (NO_3) levels were measured by colorimetric analysis with an Ocean Optics Chem2000 digital spectrophotometer and chlorophyll-a (Chl-a) concentrations were determined with a Turner Designs Model 10-AU Fluorometer following methods outlined in Parsons, Maita and Lalli (1984; *A Manual of Chemical and Biological Methods for Seawater Analysis*, Pergomon Press).

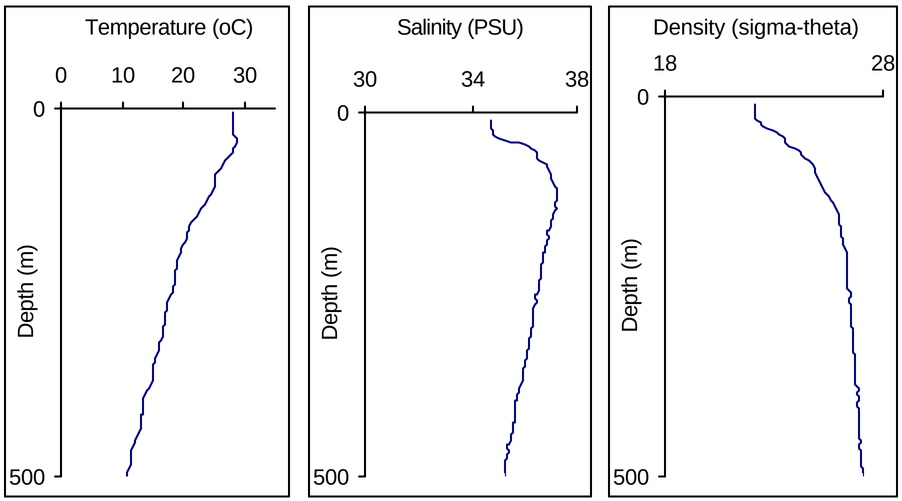
Appendix H: CTD data for C-190.

Station	Date ('03-'04)	Time (local)	Lat. (deg N)	Long. (deg W)	General Location	Cast Depth (m)
C190-009	2-Dec	8:55	16.99	-63.86	W Saba Bank	525
C190-013	3-Dec	9:11	16.26	-63.29	SW Saba Bank	483
C190-015	4-Dec	9:14	16.35	-62.89	W Guadeloupe	500
C190-017	5-Dec	9:40	15.89	-62.43	SW Guadeloupe	524
C190-019	6-Dec	10:14	15.62	-62.18	W Dominica Passage	
C190-026	8-Dec	9:35	15.00	-62.24	SW Dominica	1001
C190-028	9-Dec	8:32	13.97	-62.51	W St. Lucia Passage	434
C190-045	17-Dec	7:35	11.88	-62.24	W Grenada Passage	443
C190-052	19-Dec	8:40	11.82	-65.12	NW La Blanquilla	496
C190-060	21-Dec	8:47	13.09	-67.70	N Islas de Aves	441
C190-062	22-Dec	8:21	15.12	-68.68	Central Caribbean	470
C190-064	23-Dec	8:38	15.67	-70.62	Central Caribbean	470
C190-070	26-Dec	8:42	17.61	-75.42	S Jamaica Channel	549
C190-085	2-Jan	9:37	24.56	-84.66	Gulf of Mexico	2482
C190-086	5-Jan	9:19	24.41	-82.21	S Marquesas Keys	52
C190-088	5-Jan	14:11	24.23	-82.25	SW Marquesas Keys	576
C190-090	5-Jan	18:12	24.40	-82.08	SW Boca Grande Key	131
C190-091	5-Jan	22:49	24.24	-81.89	SW Key West	550

CTD profiles are provided in Appendix I.

Appendix I: CTD profiles of temperature (°C), salinity (PSU) and density (sigma-theta, kg/m^3) C-190. Station locations are provided in Appendix H.

009



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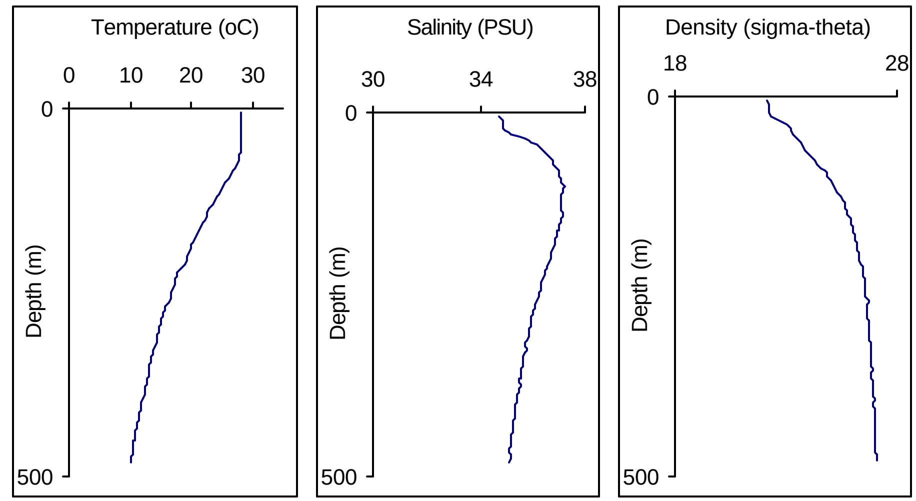

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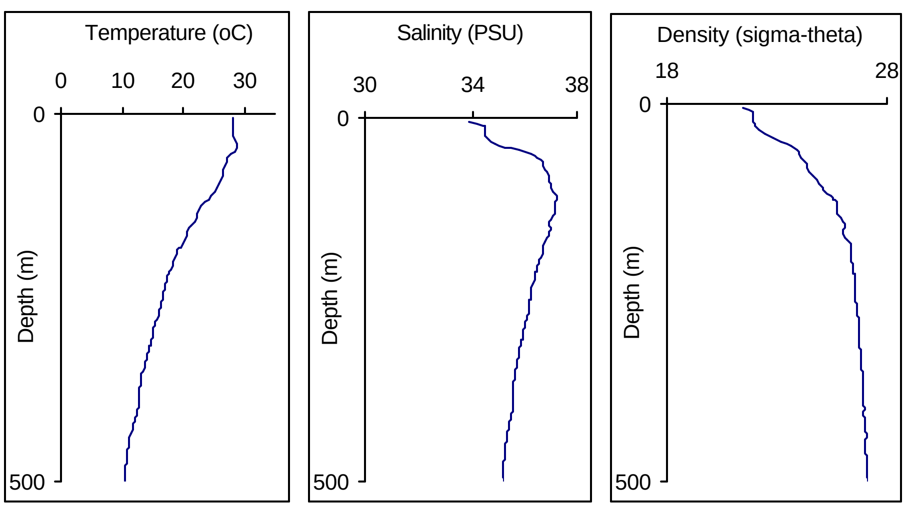

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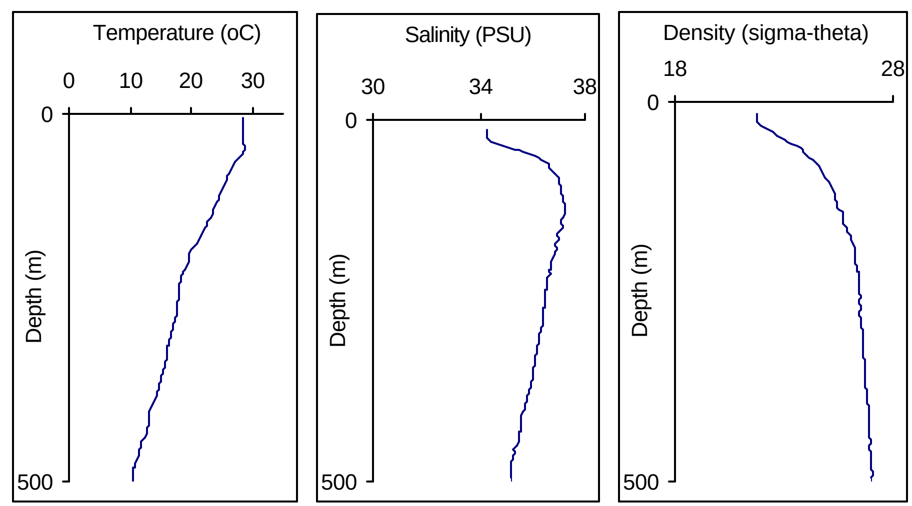

Appendix I: continued.

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Data file lost.

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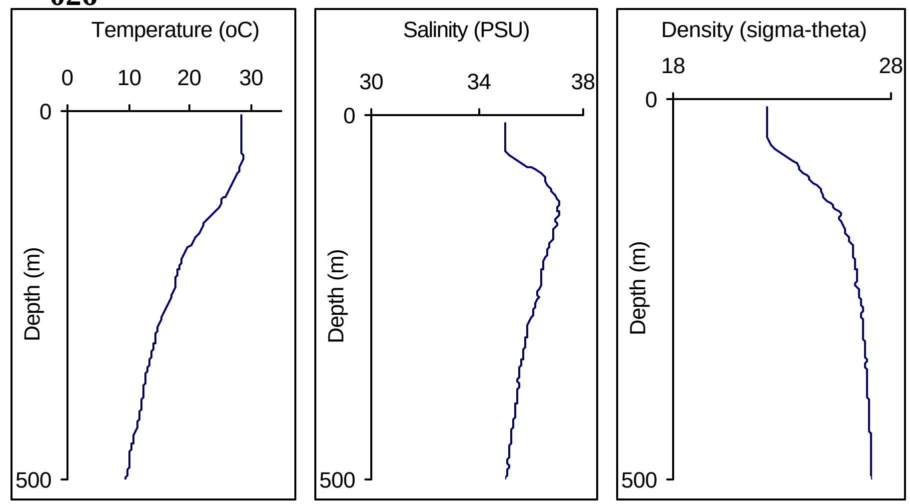

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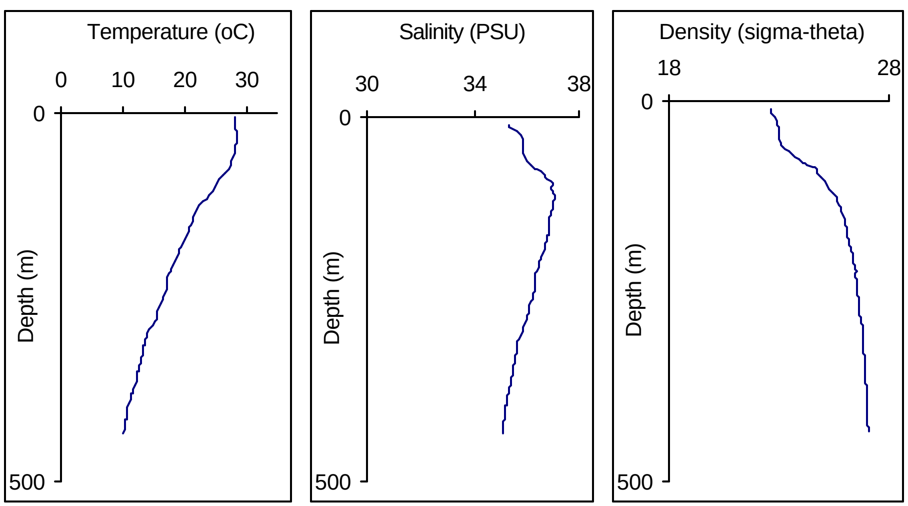

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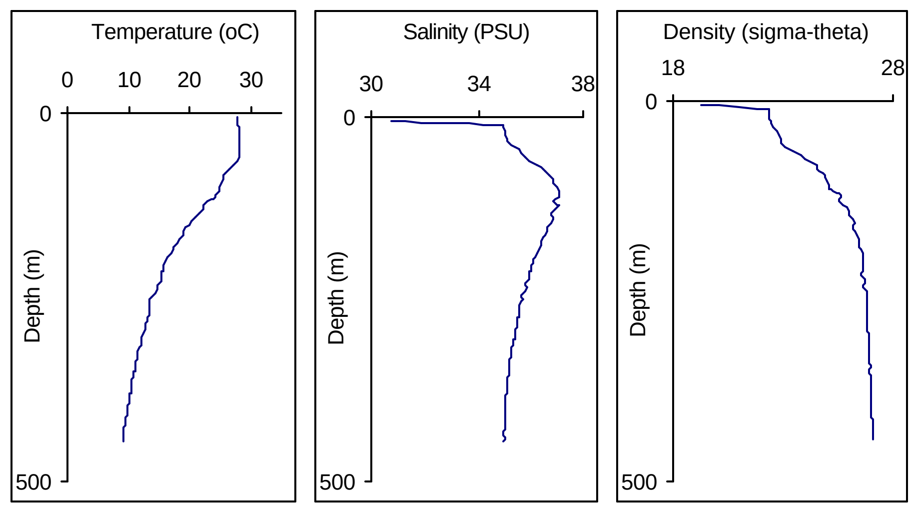
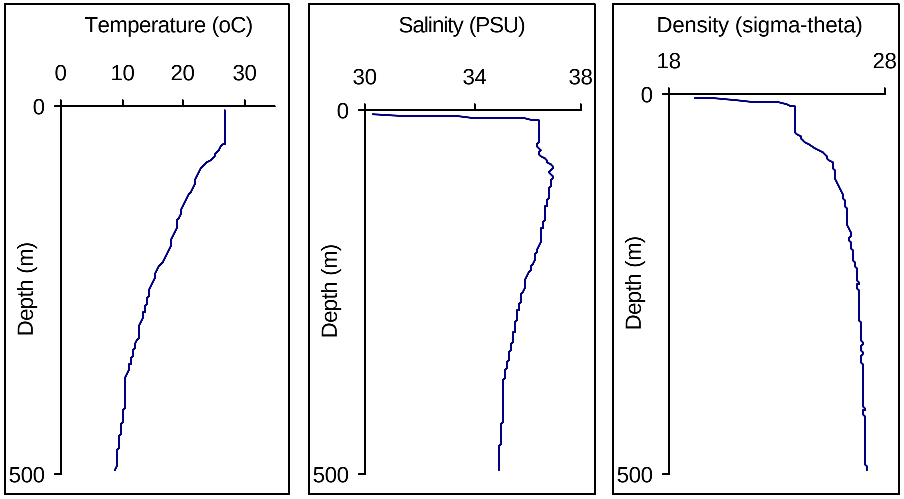


Appendix I: continued.

052



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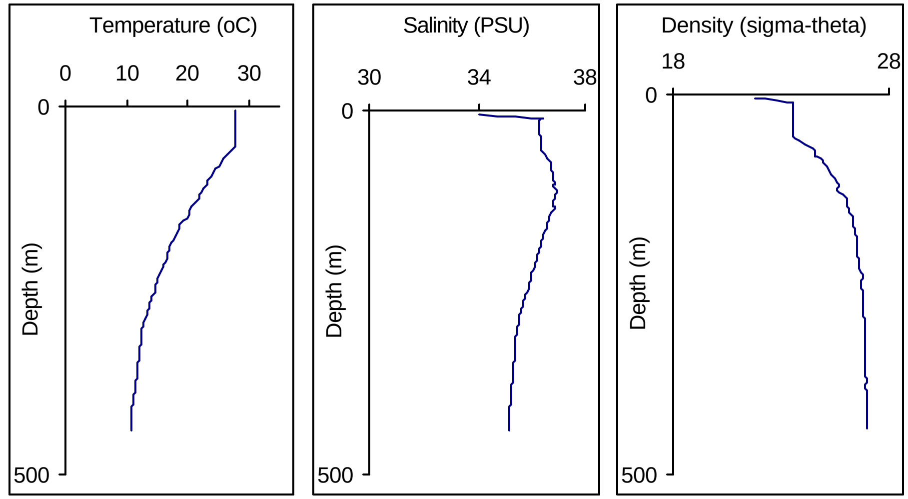

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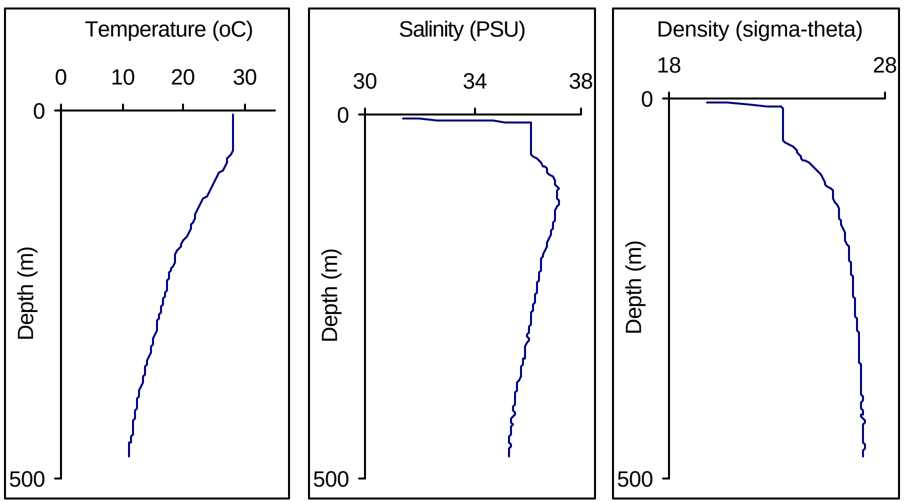

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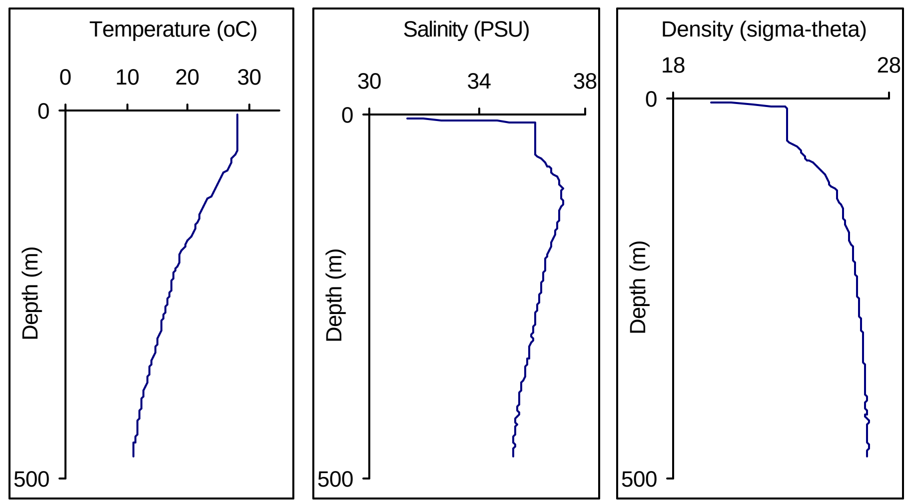
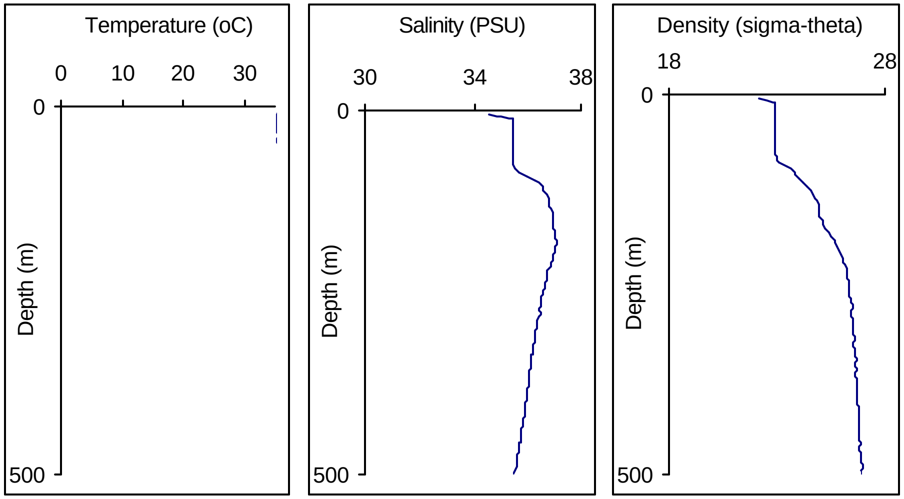


Appendix I: continued.

070



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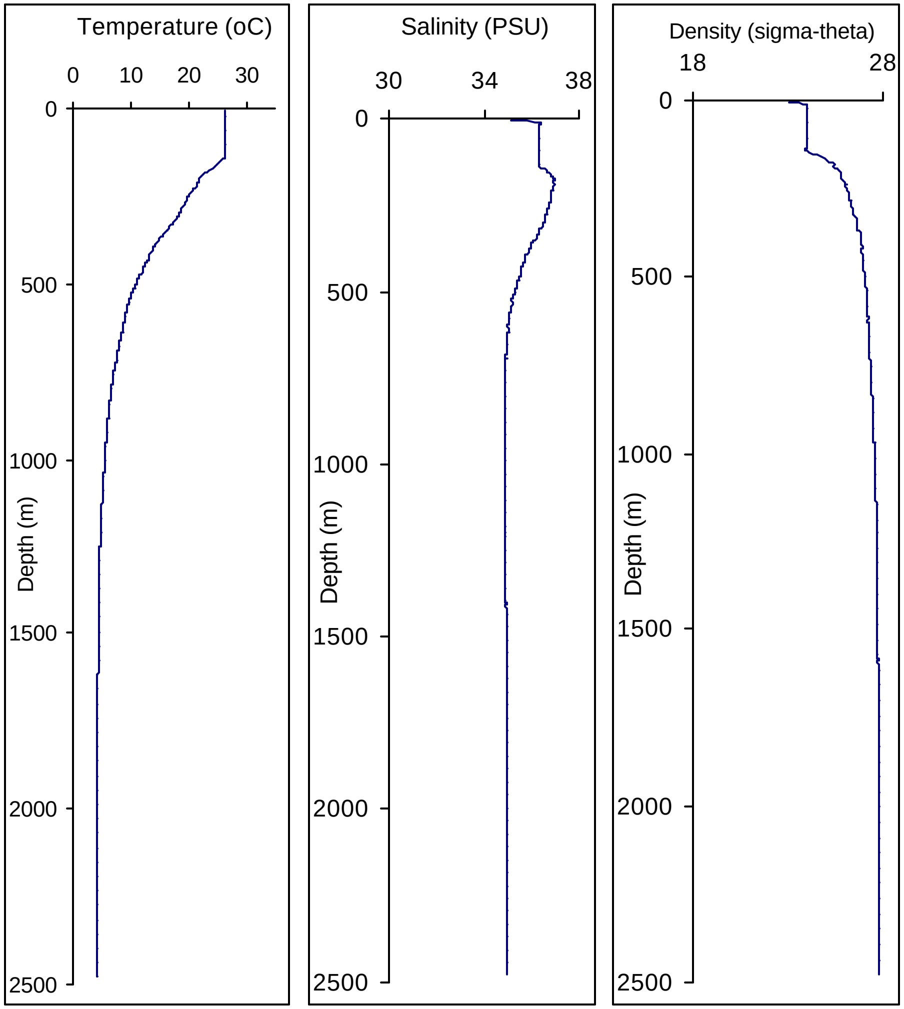
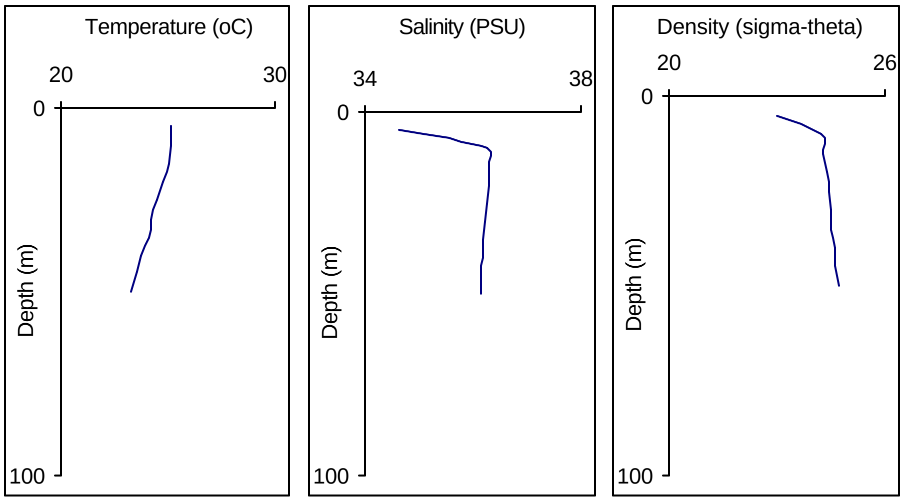
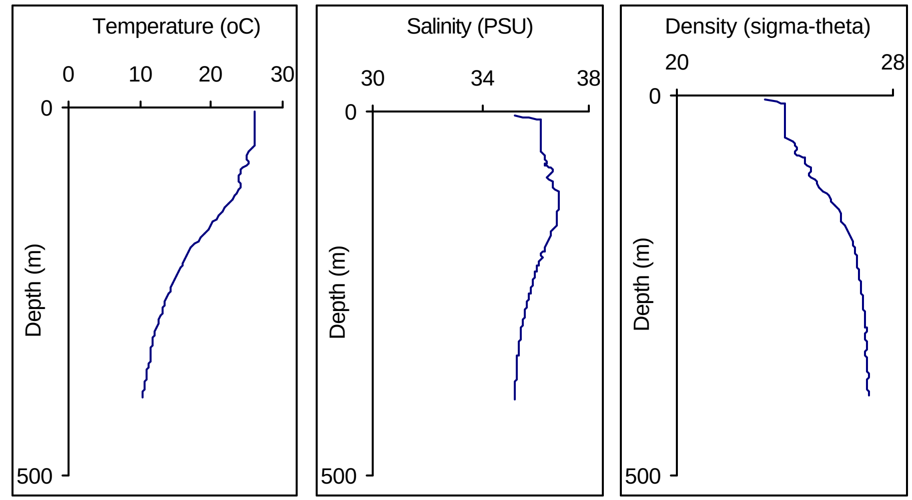


Styrocast with 2681m of wire out!!!!

86


Temperature (oC)
20
30
0
100
Depth (m)
Salinity (PSU)
34
38
0
100
Depth (m)
Density (sigma-theta)
20
26
0
100
Depth (m)

088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10
20
30
0
500
Depth (m)
Salinity (PSU)
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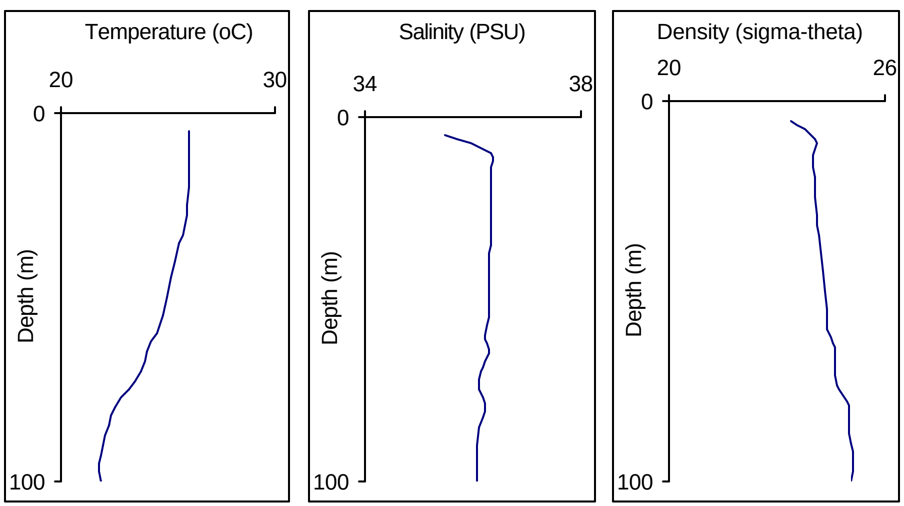
34
38
0
500
Depth (m)
Density (sigma-theta)
20
28
0
500
Depth (m)

90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20
30
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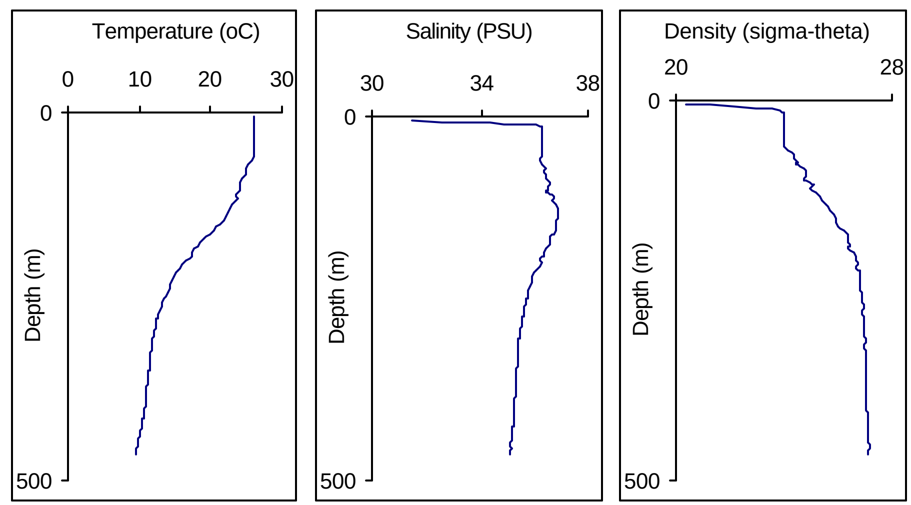
Depth (m)
Salinity (PSU)
34
38
0
100
Depth (m)
Density (sigma-theta)
20
26
0
100
Depth (m)

091


Temperature (oC)
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10
20
30
0
500
Depth (m)
Salinity (PSU)
30
34
38
0
500
Depth (m)
Density (sigma-theta)
20
28
0
500
Depth (m)

Appendix J: Midnight and noon positions for C-190.

Date ('03-'04)	Time (local)	Latitude (deg N)	Longitude (deg W)	General Location
29-Nov	12:00	17.43	-64.51	Alongside, Christiansted, St. Croix
30-Nov	0:00	17.43	-64.51	Alongside, Christiansted, St. Croix
30-Nov	12:00	17.78	-64.71	
1-Dec	0:00	18.02	-64.77	
1-Dec	12:00	17.98	-64.57	
2-Dec	0:00	17.56	-64.24	
2-Dec	12:00	17.07	-63.88	
3-Dec	0:00	16.88	-63.67	
3-Dec	12:00	16.09	-63.24	
4-Dec	0:00	15.91	-62.96	
4-Dec	12:00	16.20	-62.87	
5-Dec	0:00	16.02	-62.61	
5-Dec	12:00	15.77	-62.45	
6-Dec	0:00	15.49	-62.27	
6-Dec	12:00	15.60	-62.24	
7-Dec	0:00	16.21	-61.82	
7-Dec	12:00	15.83	-61.90	
8-Dec	0:00	15.25	-62.17	
8-Dec	12:00	14.94	-62.30	
9-Dec	0:00	14.21	-62.47	
9-Dec	12:00	13.85	-62.66	
10-Dec	0:00	13.35	-62.63	
10-Dec	12:00	12.65	-62.50	
11-Dec	0:00	12.51	-62.11	
11-Dec	12:00	12.59	-61.57	
12-Dec	0:00	12.56	-61.49	
12-Dec	12:00	12.48	-61.46	At anchor Hillsborough, Carriacou
13-Dec	0:00	12.48	-61.46	At anchor Hillsborough, Carriacou
13-Dec	12:00	12.48	-61.47	At anchor Hillsborough, Carriacou
14-Dec	0:00	12.48	-61.47	At anchor Hillsborough, Carriacou
14-Dec	12:00	12.48	-61.47	At anchor Hillsborough, Carriacou
15-Dec	0:00	12.48	-61.47	At anchor Hillsborough, Carriacou
15-Dec	12:00	12.63	-61.49	
16-Dec	0:00	12.74	-61.61	
16-Dec	12:00	12.60	-61.60	
17-Dec	0:00	12.30	-61.93	
17-Dec	12:00	11.75	-62.48	
18-Dec	0:00	11.58	-63.32	
18-Dec	12:00	11.68	-64.15	
19-Dec	0:00	11.79	-64.78	
19-Dec	12:00	11.81	-65.32	
20-Dec	0:00	11.72	-66.02	
20-Dec	12:00	11.97	-66.76	
21-Dec	0:00	12.35	-67.27	
21-Dec	12:00	13.20	-67.94	
22-Dec	0:00	14.36	-68.31	
22-Dec	12:00	15.18	-68.90	
23-Dec	0:00	15.53	-69.95	
23-Dec	12:00	15.64	-70.68	
24-Dec	0:00	15.62	-71.15	

24-Dec	12:00	15.67	-71.63	
25-Dec	0:00	16.11	-72.69	
25-Dec	12:00	16.64	-73.92	
26-Dec	0:00	17.30	-74.98	
26-Dec	12:00	17.56	-75.41	
27-Dec	0:00	17.61	-76.41	
27-Dec	12:00	17.60	-77.23	
28-Dec	0:00	17.53	-78.16	
28-Dec	12:00	17.43	-78.97	
29-Dec	0:00	18.04	-79.98	
29-Dec	12:00	18.88	-80.99	
30-Dec	0:00	18.99	-81.62	
30-Dec	12:00	19.65	-82.58	
31-Dec	0:00	20.41	-83.55	
31-Dec	12:00	20.49	-83.63	
1-Jan	0:00	22.23	-85.15	
1-Jan	12:00	22.35	-85.17	
2-Jan	0:00	24.55	-84.89	
2-Jan	12:00	24.51	-84.67	
3-Jan	0:00	23.83	-84.26	
3-Jan	12:00	23.50	-83.79	
4-Jan	0:00	24.18	-83.13	
4-Jan	12:00	24.31	-83.17	
5-Jan	0:00	24.53	-82.61	
5-Jan	12:00	24.35	-82.25	
6-Jan	0:00	24.25	-81.84	
6-Jan	12:00	24.25	-81.84	At anchor off Key West
7-Jan	0:00	24.53	-81.81	At anchor off Key West
7-Jan	12:00	24.53	-81.81	At anchor off Key West
8-Jan	0:00	24.53	-81.81	At anchor off Key West

The Banana Song

Take the banana position

Peel banana, peel, peel banana
Peel banana, peel, peel banana
(appropriate hand motions)

Eat banana, eat, eat banana
Eat banana, eat, eat banana
(appropriate hand motions)

Go bananas, go, go bananas
Go bananas, go, go bananas
(crazy dancing)

The Nut and Wall Song

Be a nut, be, be a nut
Be a nut, be, be a nut

Crack the nut, crack, crack the nut
Crack the nut, crack, crack the nut

Go nuts, go, go, go nuts
Go nuts, go, go, go nuts

Build the wall, build, build the wall
Build the wall, build, build the wall

Wipe the wall, wipe, wipe the wall
Wipe the wall, wipe, wipe the wall

Go Field Day!!!!

The ADCP Song
Tom and Will - January 2004

Chorus
G
Oh, ADCP
E
How much you mean to me
G C
Tracking the current wherever we go
A D
Swimming the way the waters do flow
G C
Down the Antilles and through Yucatan
A D
Together we've covered the Cari-bbe-an

Chorus x 2

G C
Helping to get the data for Jeff
A D
We want to know if it goes right or left
G C
So we've been watching currents in the sea
A D
And that's why we love our ADCP

Chorus x 2

Fade out…

The 12 Days of SEA Christmas

On the 12th day of Christmas, SEA gave to me:

12 bottles to winkle
11 dolphins jumping
10 sails ' a flying
9 lost lunches
8 running fixes
7 hundred counts
6 daily meals
5 field days
4 hours of sleep
3 freshwater showers
2 ripped JTs
and a big sexy schooner on the sea!!

The Quitter

When your're lost in the Wild, and you're scared as a child
And Death looks you bang in the eye,
And you're sore as a boil, it's according to Hoyle
To cock your revolver and…die.
But the Code of a Man says: "Fight all you can,"
And self-dissolution is barred.
In hunger and woe, oh, it's easy to blow…
It's the hell-served-for-breakfast that's hard.

"You're sick of the game!" Well, now, that's a shame.
You're young and you're brave and you're bright.
"You've had a raw deal!" I know – but don't squeal,
Buck up, do your damnedest, and fight.
It's the plugging away that will win you the day,
So don't be a piker, old pard!
Just draw on your grit; it's so easy to quit:
It's the keeping-your-chin-up that's hard.

It's easy to cry that you're beaten – and die;
It's easy to crawfish and crawl;
But to fight and to fight when hope's out of sight –
Why, that's the best game of them all!
And though you come out of each grueling bout,
All broken and beaten and scarred,
Just have one more try – it's dead easy to die,
It's the keeping-on-living that's hard.

Robert Service

Ithaka

When you set out for Ithaka
Ask that your way be long,
Full of adventure, full of instruction.
The Laistrygonians and the Cyclops,
Angry Poseidon – do not fear them;
Such as these you will never find
As long as your thought is lofty,
As long as a rare emotion
Touch your spirit and your body.
The The Laistrygonians and the Cyclops,
Angry Poseidon – you will not meet them
Unless you carry them in your soul,
Unless your soul raise them up before you.

Ask that your way be long
At many a summer dawn to enter –
With what gratitude, what joy!
Ports seen for the first time;
To stop at Phoenecian trading centers,
And to buy good merchandise:
Mother of pearl and coral, amber and ebony,
And sensuous perfumes of every kind.
Buy as many sensuous perfumes as you can,
Visit many Egyptian cities
To learn and learn from those who have knowledge.

Always keep Ithaka fixed in your mind
Your arrival there is what you are destined for.
But do not in the least hurry the journey.
Better that it last for years
So that when you reach the island you are old
Rich with all that you have gained on the way,
Not expecting Ithaka to give you wealth.
Ithaka has given you the splendid voyage.
Without her you would never have set out,
But she has nothing more to give you.
And if you find her poor,
Ithaka has not deceived you.
So wise have you become, of such experience,
That already you will have understood
What these Ithakas mean.

C. P. Cavafy

Ballad of C190
Tom and Will – 7 January 2004

We've been sailing all around	D
With the crazy Cramer crew	D
And so Tom and Will wrote a song	G
And its all about you	G

The CHIRP is not dead
Oh no the CHIRP is not dead
The CHIRP is not dead
Oh no it's stuck in my head

A Watch has their drama	A
Sometimes they rave and rant	C
But they always get through it	D
With just a little chant	E

Charlie's still a sass mouth
And Will might be a Sasquatch
But no one rocks the wake ups
Quite like B Watch

They ask lots o' questions
Its what they do best
When turning over to C Watch
Its like taking a test

Chorus

When we're at Ship's Meeting
La la la la la la
Do do do do do do
What's that? Speak up!
I can't hear you!

We did lots of reports
In science and navigation
Oh wait… what's that?
I think Rob has a question!

We learned most of the lines
And the riggin' we tried to figure
But we're still looking for
That pesky raffe jigger.

Chorus