VOLUME 3 - FINAL REPORT II

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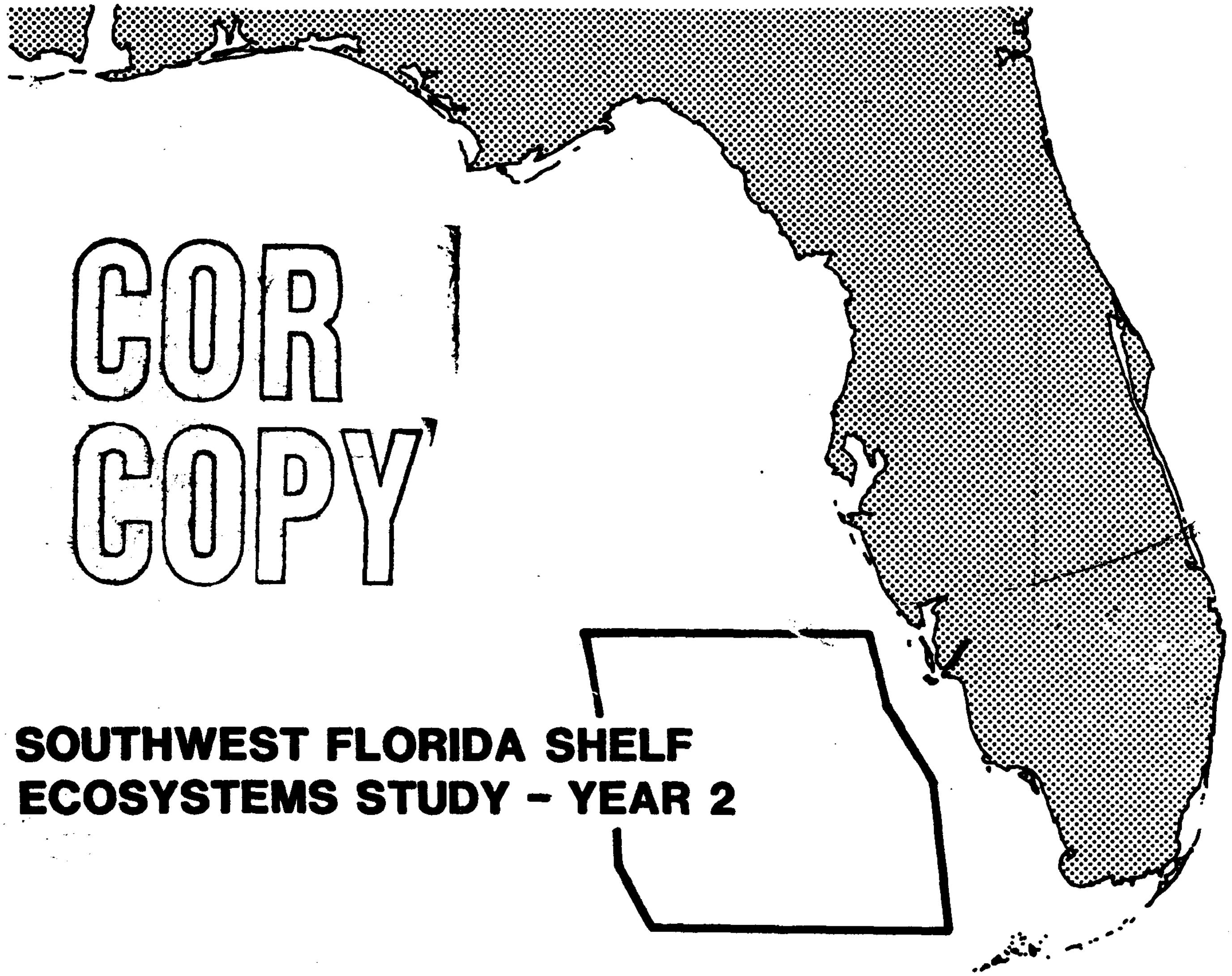

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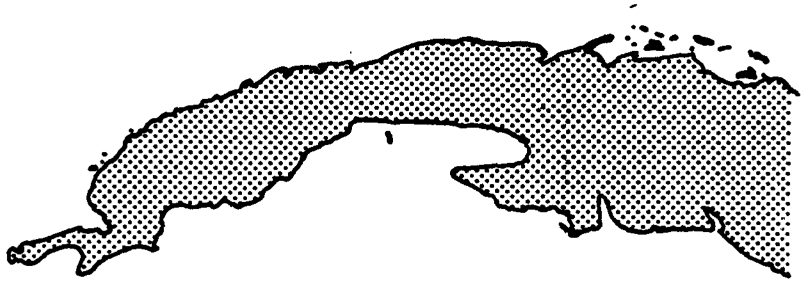
SOUTHWEST FLORIDA SHELF ECOSYSTEMS STUDY - YEAR 2



Prepared for:
U.S. Department of the Interior, Minerals Management Service
Gulf of Mexico OCS Region, Metairie, Louisiana
Contract 14-12-0001-29144
July 1985

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VOLUME 3 - FINAL REPORT II

SOUTHWEST FLORIDA SHELF ECOSYSTEMS STUDY - YEAR 2

Prepared for
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July 1985

Woodward-Clyde Consultants
Consulting Engineers, Geologists and Environmental Scientists

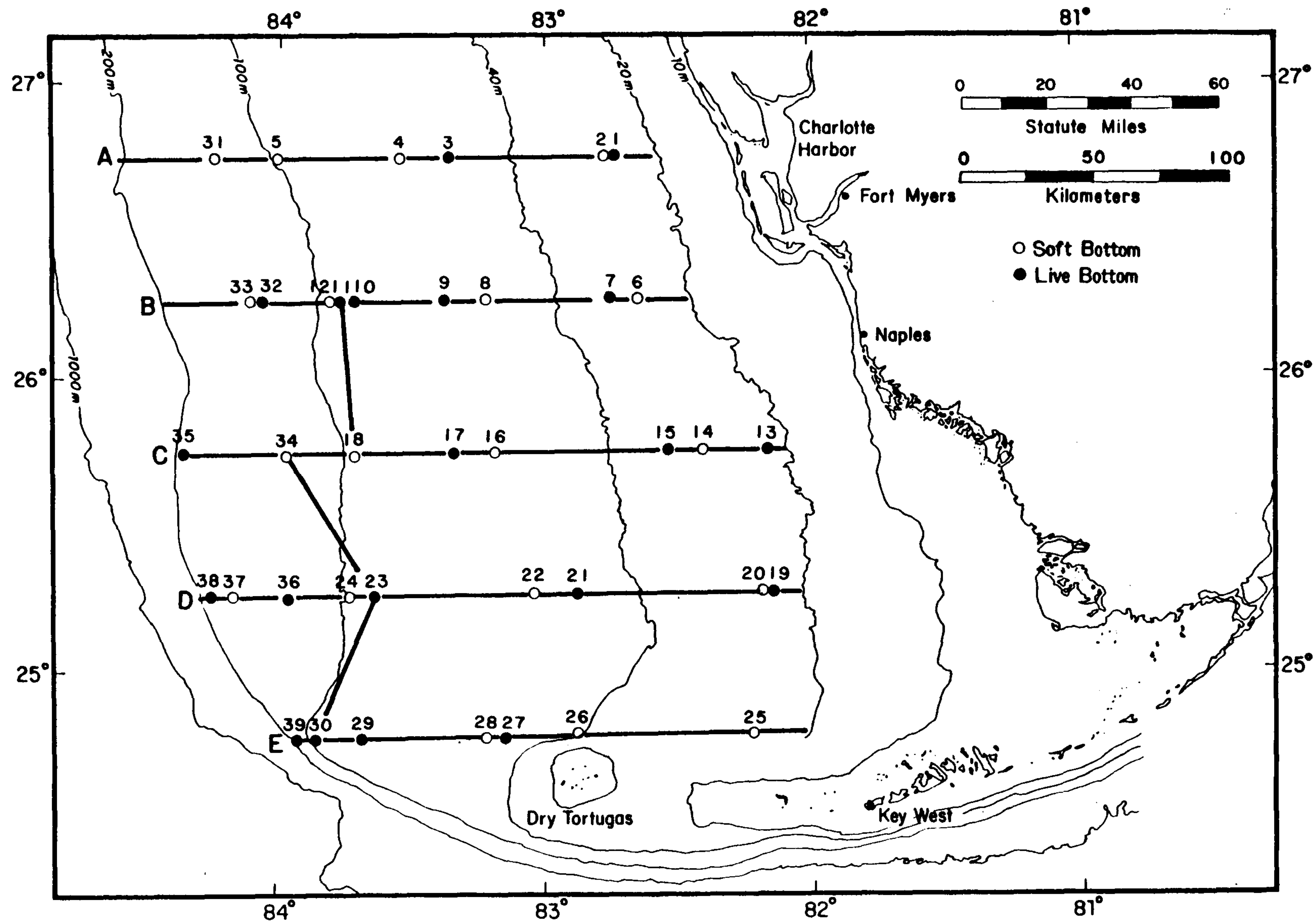
Continental Shelf Associates, Inc.
CSA
"Applied Marine Science and Technology"

PREFACE

THE SOUTHWEST FLORIDA SHELF ECOSYSTEMS STUDY

To meet present and future energy requirements of the United States, the Department of the Interior has acted to expedite development of oil and gas deposits beneath the outer continental shelf (OCS). Under the Department's accelerated 5-year leasing program, the Minerals Management Service (MMS) is proposing to offer for lease certain tracts in the eastern Gulf of Mexico. The protection of marine and coastal environments is mandated by the OCS Lands Act of 1963, the National Environmental Policy Act of 1969, and the OCS Lands Act Amendments of 1978. As manager of the OCS Leasing Program, the Department of the Interior is responsible for ensuring that proposed OCS development will not irreparably damage the marine environment and its resources. To help meet this responsibility, and to provide basic environmental information for the eastern Gulf of Mexico, the Minerals Management Service initiated (1980) the multiyear, multidisciplinary, Southwest Florida Shelf Ecosystems Study Program.

During Year One of the Southwest Florida Shelf Ecosystems Study Program, bathymetric, seismic, and side scan sonar data were collected (September-October 1980), along with underwater television and still camera color photography of the sea floor. These data were augmented by analyses of a broad range of hydrographic measurements, and water column, sediment, and benthic biological samples. Sampling stations were established in water depths ranging from 20 to 90m at 30 locations distributed along five east-west shelf transects (Figure, Transects A through E). Biological and hydrographic sampling were completed in fall (October-November) 1980 and spring (April-May) 1981.



Southwest Florida shelf survey transects (A through F) and benthic sampling stations for Year One and Two programs.

During the Year Two program, additional visual and geophysical data were collected along a north-south tie-line (Figure, Transect F). Twenty-one of the 30 first year hydrographic and biological sampling stations were resampled twice more, once during summer (July-August) 1981, and again during winter (January-February) 1982. In addition, nine new sampling stations were established on Transects A through E, in water depths ranging from 100 to 159m.

A third study phase, the Year Two Modification contract, examined the importance of Loop Current frontal eddies to primary production along the outer edge of the southwest Florida shelf. This phase encompassed two seasonal hydrographic cruises, in April and September 1982, and included direct and indirect measurements of primary productivity. These hydrographic and primary productivity data have now been synthesized with previous study results into an overview of the driving energetic forces within the southwest Florida shelf regional ecosystem.

The southwest Florida continental shelf includes sandy soft bottom sea floor substrates;[1] hard, "live bottom" habitat; and other areas which favor the development and concentration of marine biota. The distribution of these bottom types and their significance to the regional marine benthic and water column ecosystem is not well known. The interpretation and synthesis of data from this Program are directed at general characterization of broad areas of the southwest Florida shelf, characterization of individual study sites, and inter-site comparisons; assessment of OCS development impact/enhancement potential; methodology evaluation; water mass characterization; and formulation of recommendations for future studies.

The results of the Year One program have already been reported (Woodward-Clyde Consultants and Continental Shelf Associates, Inc., 1983), as have the results of phase three (Woodward-Clyde Consultants and Skidaway Institute of Oceanography, 1983). The present Year Two Final Report describes the results of the Year Two program and provides an integration and synthesis of information collected during all three phases of the study.

The Southwest Florida Shelf Ecosystems Study Program has expanded considerably beyond the work reported herein. Year Three (Continental Shelf Associates, Inc.) continued seafloor habitat mapping to fill in areas between the Year One and Two study transects. Inshore biological sampling stations were also established in 10 to 20m water depths. Years Four and Five (Environmental Science & Engineering) were concerned with dynamic processes that affect the shelf ecosystem -- bottom currents, sediment movements, and so forth. A sixth program year presently contemplates a thorough synthesis of all preceeding study results.

The Year Two Final Report includes a total of seven (7) volumes, as follows:

Volume 1 - Executive Summary, provides a brief, abstracted summary of the principal goals, methods used, and results obtained during the study program.

Volume 2 - Final Report I, includes a more complete introduction to the Year One and Two programs, a summary of geophysical results, a complete discussion of methods used, and accounts of the physical oceanography and substrates that characterize the southwest Florida shelf.

Volume 3 - Final Report II, includes detailed accounts of the live bottom and soft bottom biota of the shelf.

Volume 4 - Final Report III, presents a synthesis of the physical variables and biological assemblages, outlines the potential impacts of OCS development, and provides lists of literature cited and program acknowledgments.

Volume 5 - Appendix A, provides copies of Year One and Year Two hydrographic and biological sampling cruise logs, sample collection times, station tract plots, and hydrographic and sediment data collected during both study years.

Volume 6 - Appendix B, includes the Master Taxon Code List for all taxa recorded during the program, and computer listings of all soft bottom sample station otter trawl and box core data collected during Years One and Two.

Volume 7 - Appendix C, provides computer listings of the live bottom sample station otter trawl, triangle dredge, and quantitative slide analysis data sets for Years One and Two.

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6.0 LIVE BOTTOM BIOTA

6.1 INTRODUCTION

As described in previous sections, 20 live bottom stations were characterized using remote video and still camera photography and dredge and trawl collections in the course of four biological cruises. For reference, the locations of all live bottom stations are shown on Figure 6-1. Fifteen stations at depths ranging from 20 to 77m were sampled during the first two cruises (Year One); for the two Year Two cruises, five of these stations were replaced by stations ranging in depth from 127 to 159m. Station depths and sampling dates are summarized in Table 6-1.

This section describes the results of biological sampling at the live bottom stations. Characteristics of individual stations are described first, followed by descriptions of shelfwide distribution patterns, zonation, and seasonality. The ecology of the live bottom communities of the shelf is then discussed and the results compared with those of previous studies in the area. Further discussion of the live bottom biota in the context of the shelf ecosystem is provided in Section 8.0, and potential impacts of oil and gas operations are evaluated in Section 9.0.

6.2 METHODS AND MATERIALS

All field and laboratory methods for assessing live bottom biota have been provided in Section 3.0. A brief summary of methodology follows.

At each station, approximately 200 35-mm color photographs were taken during a TV/still camera tow within a 1 km^2 area around the station center. Generally, 100 photographs were later analyzed to obtain percent cover estimates for all biota and for particular identifiable taxa, using quantitative slide analysis (QSA). Following the television/still camera tow at each station, dredge

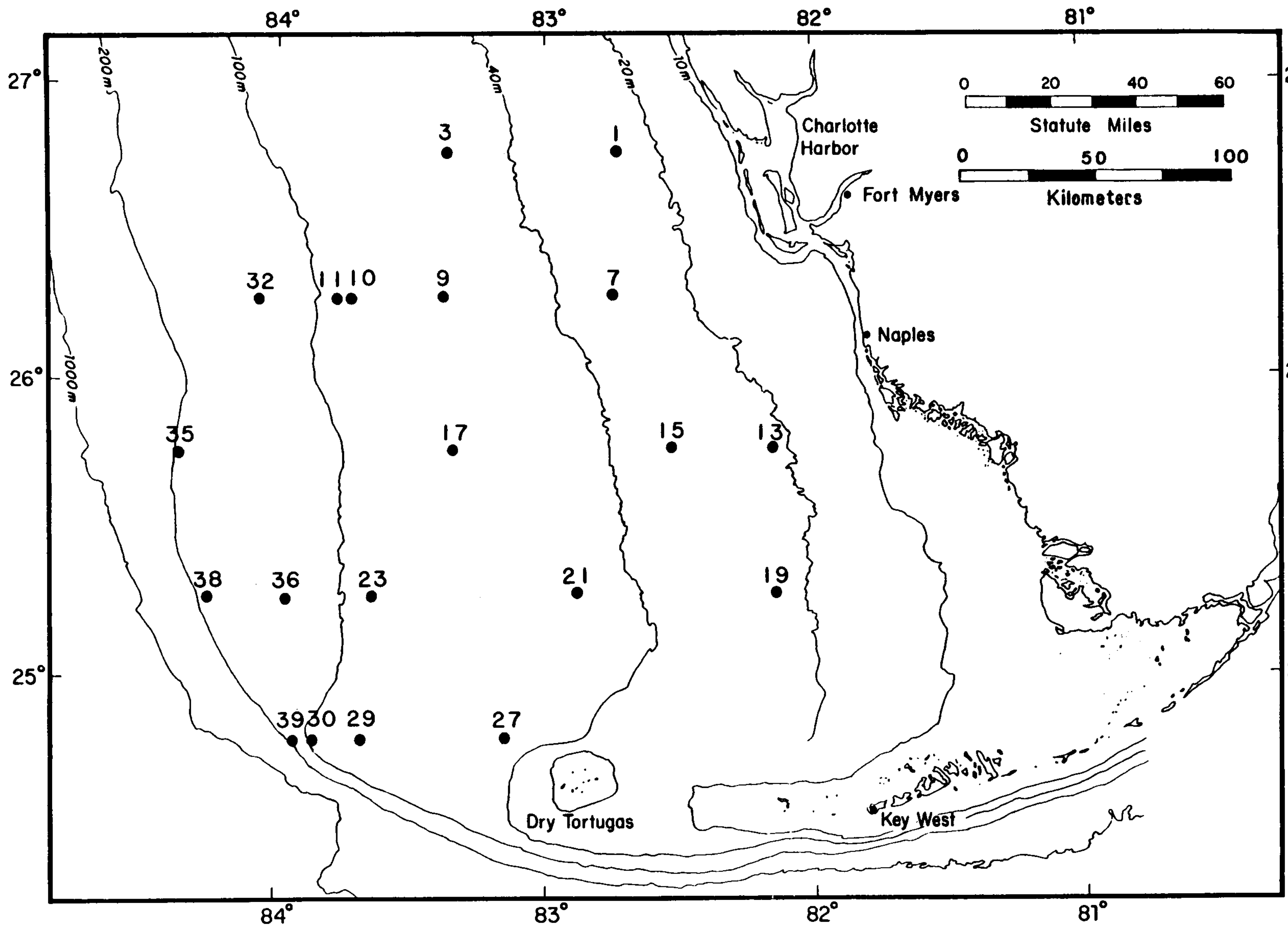


Figure 6-1. Locations of live bottom sampling stations.

Table 6-1. Summary of station depths and sampling frequency for live bottom stations.

Station	Transect	Depth (m)	Cruise: Fall	Spring	Summer	Winter
1	A	24	X	X	X	X
3	A	50	X	X	X	X
7	B	30	X	X	X	X
9	B	56	X	X	X	X
10	B	71	X	X		
11	B	77	X	X	X	X
13	C	20	X	X	X	X
15	C	32	X	X	X	X
17	C	58	X	X		
19	D	22	X	X		
21	D	44	X	X	X	X
23	D	70	X	X	X	X
27	E	54	X	X		
29	E	62	X	X	X	X
30	E	76	X	X		
32	B	137			X	X
35	C	159			X	X
36	D	127			X	X
38	D	159			X	X
39	E	152			X*	X*

Fall Cruise = Year One, Cruise 3 (October-November 1980)
Spring Cruise = Year One, Cruise 4 (April-May 1981)
Summer Cruise = Year Two, Cruise 2 (July-August 1981)
Winter Cruise = Year Two, Cruise 3 (January-February 1982)

*No trawl samples were obtained at Station 39. Dredge samples were obtained using a rock dredge rather than the triangle dredge used at all other stations.

and trawl samples were taken to obtain specimens of most epibiotal taxa. Three triangle dredge (Kahlsico; 0.6m opening, 1.2cm mesh) and one otter trawl (Marinovitch semiballoon otter trawl, 7.6m) samples were obtained at each station; the trawls were intended to supplement dredge samples by capturing more fishes, certain crustaceans, and larger sponges that may not fit in the dredge opening. Epibiota were photographed on deck, rough sorted, and preserved for later laboratory identification. Data analysis included normal and inverse cluster analyses and discriminant analysis. Only results of classification (cluster) analyses are included in this chapter; results of the analyses designed to examine organism/environment relationships are presented in the context of the shelf as an ecosystem in Section 8.0.

6.3 ECOLOGICAL CHARACTERIZATION OF INDIVIDUAL STATIONS

6.3.1 Station 1

Physical Features -- Station 1 was located at 26°45.77'N, 82°43.11'W; 41 km from shore. Across the stations there was little apparent slope, with depths ranging from 24 to 25m. Thick sand bottom and thin sand veneer over hard bottom substrates predominated at this site. Occasional rock outcrops of up to 0.6m relief were also observed.

Taxonomic Richness & Composition -- Table 6-2 summarizes the taxonomic richness and general composition of the biota at Station 1. Numbers of taxa (identified to genus or species level) within major groups captured are presented comparatively for each sampling technique used. Columns 1 and 2 list the numbers of taxa recorded by triangle dredge (TDS) and QSA, respectively. No taxa were identified in QSA that were not present in dredges or trawls. Column 5 lists the number of otter trawl (OTH) taxa, and Column 6 lists the number of OTH taxa that were not also obtained in dredges at the station.

In all, 386 taxa (identified to genus or species) were collected at Station 1. The predominant groups (listed in order of decreasing numbers of taxa) included Crustacea, Porifera (sponges), Gnathostomata (fishes), Rhodophycophyta (red algae), and Gastropoda (gastropod molluscs). Collectively, these groups

Table 6-2. Station 01, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	2	0	0	2	0	0	2
CHLOROPHYCOPHYTA	23	6	0	23	9	1	24
PHAEOPHYCOPHYTA	15	3	0	15	7	1	16
RHODOPHYCOPHYTA	38	3	0	38	18	3	41
ANTHOPHYTA	2	0	0	2	2	0	2
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	41	10	0	41	12	3	44
CNIDARIA	14	5	0	14	7	3	17
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	33	0	0	33	2	0	33
POLYPLACOPHORA	3	0	0	3	0	0	3
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	23	0	0	23	7	0	23
SCAPHOPODA	2	0	0	2	0	0	2
CEPHALOPODA	2	0	0	2	0	0	2
ARTHROPODA-PYCNOGONIDA	1	0	0	1	1	0	1
ARTHROPODA-MANDIBULATA-CRUSTACEA	65	0	0	65	15	1	66
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	17	0	0	17	8	2	19
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	24	2	0	24	10	1	25
HEMICHORDATA	1	0	0	1	1	0	1
CHORDATA-UROCHORDATA	22	2	0	22	12	0	22
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	29	0	0	29	25	14	43
TOTAL	357	31	0	357	136	29	386

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

accounted for 59% of the taxa collected. Station 1 had the highest number of algal taxa collected at any station.

Table 6-3 lists some of the most frequently collected taxa from Station 1.

Epibiotal Cover -- Percent cover varied seasonally, being highest in summer and lowest in winter (Table 6-4). Algae dominated epibiotal cover during all seasons, though the particular group(s) responsible varied (Table 6-4); red and green algae dominated during summer, and green and brown algae dominated during fall. Brown algae were abundant only during winter (*Sargassum* sp.) and (especially) spring, when they dominated epibiotal cover. The slightly higher contribution of sponges and hard corals during winter and spring partly reflects the lower abundance of algae that could cover or obscure underlying epibiota in the photographs.

The maximum abundance of red algae in summer corresponded to an elevated number of red algal taxa captured in dredges and trawls. In contrast, brown algal cover was highest (winter, spring) when only a few species were captured in dredges and trawls (*Sargassum* sp., *S. hystrix*, *Rosenvingea intricata*). *Sargassum* sp. was a major component of total brown algal cover, and it is apparent that *Sargassum* and perhaps one or two other brown algae were able to "bloom" under winter/spring conditions.

Additional Remarks -- Station 1 was unique in its high algal richness and high contribution by seasonally abundant algae in contrast to suspension-feeders (sponges, ascidians, etc.). Algal and seagrass-dominated assemblages have since been noted in shallower water (<20m) during Year Three of this study, although no stations inshore of Station 1 were occupied.

6.3.2 Station 3

Physical Features -- Station 3 was located at 26°45.86'N, 83°21.44'W; 96 km from shore. Across the station there was a slight downward slope from WNW to ESE, with depths ranging from 49 to 50m. Thick sand bottom substrate pre-

Table 6-3. Species collected in at least 9 of 12 dredge samples or 3 of 4 trawl samples from Station 1.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Laurencia intricata	11	3
Udotea conglutinata	9	2
U. cyathiformis	9	2
Gracilaria debilis	9	2
PORIFERA		
Cinachyra alloclada	12	4
Homaxinella waltonsmithi	9	2
CNIDARIA		
Siderastrea radians	11	0
Cladocora arbuscula	10	3
Solenastrea hyades	10	1
Phyllangia americana	9	1
CRUSTACEA		
Gonodactylus bredini	11	2
Podochela riisei	10	2
Macrocoeloma camptocerum	9	2
BRYOZOA		
Celleporaria magnifica	10	3
Stylopoma spongites	10	0
ECHINODERMATA		
Ophiolepis elegans	12	3
Arbacia punctulata	11	1
Lytechinus variegatus carolinus	10	3
Ophiothrix angulata	9	2
Luidia alternata	3	3
ASCIDIACEA		
Rhabdopleura compacta	10	2
FISHES		
Serraniculus pumilio	5	3
Hippocampus erectus	3	3
Synodus foetens	0	3
Diplectrum formosum	0	3

Table 6-4. Station 1: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and for major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer	26.8	9.8 Chlorophycophyta (0.9 *Udotea* sp.) 13.8 Rhodophycophyta (0.9 Cryptonemiales; 1.4 *Gracilaria* sp.) 1.9 Phaeophycophyta (1.7 *Rosenvingea intricata*
Fall	15.4	7.9 Chlorophycophyta (1.0 *Udotea* sp.) 6.1 Phaeophycophyta 0.7 Porifera
Winter	13.3	7.7 Phaeophycophyta (6.6 *Sargassum* sp.) 1.9 Cnidaria (1.1 *Siderastrea* sp., 0.7 *Cladocora arbuscula*) 2.0 Porifera 1.0 Chlorophycophyta
Spring	20.0	15.2 Phaeophycophyta 2.5 Porifera (1.3 *Cinachyra* spp.) 1.1 Cnidaria (0.9 *Oculina* sp.) 0.8 Chlorophycophyta

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

dominated at this site, with generally lesser amounts of thin sand veneer over hard bottom substrate. A few small rock outcrops were also observed.

Taxonomic Richness & Composition -- Taxonomic richness and composition of the biota at Station 3 are summarized in Table 6-5. A total of 526 taxa (identified to genus or species level) were collected from this station. Predominant groups (listed in order of decreasing number of taxa) included Porifera, Crustacea, Gnathostomata (fishes), Gastropoda, and Cnidaria (hydroids, anemones, soft and hard corals). Collectively, these groups accounted for 69% of the taxa observed. Station 3 had the highest number of total taxa, as well as the highest number of mollusc and fish taxa (tied with Station 9).

Table 6-6 lists some of the most frequently captured taxa from Station 3.

Epibiotal Cover -- Total epibiotal cover varied seasonally, being highest in summer and lowest in fall and winter (Table 6-7). Sponges dominated percent cover estimates in all seasons except summer, when a combination of green, red, and blue-green algal cover and the ascidian *Didemnum candidum* dominated (Table 6-7). Red algal cover was highest during summer, whereas green algal cover was higher during summer, fall, and winter (*Cystodictyon* sp.) and brown algae were abundant only during spring. Relatively little of this algal cover was identifiable to genus or species level. Some of the green algal cover was contributed by species such as *Halimeda gracilis* and *Cystodictyon pavonium*, which were present year-round at the station.

As observed at Station 1, the number of red algal taxa was at a maximum when percent cover was highest (summer), whereas phaeophyte cover was highest during spring when no taxa were even collected in dredge or trawl samples. The blue-green algal "bloom," although not major at this station, was a common feature at some other shallow stations, as described later.

Additional Remarks -- Station 3 was located in a relatively small patch of live bottom on Transect A; the extent of the patch was not sufficient for it to appear on shelfwide maps of biological assemblages (see Figure 6-2 later in this chapter).

Table 6-5. Station 03, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	10	6	0	10	9	1	11
PHAEOPHYCOPHYTA	5	2	0	5	10	7	12
RHODOPHYCOPHYTA	18	2	0	18	10	4	22
ANTHOPHYTA	1	0	0	1	1	0	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	79	21	0	79	54	16	95
CNIDARIA	37	0	0	37	23	6	43
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	61	0	0	61	17	8	69
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	22	0	0	22	7	2	24
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	3	0	0	3	2	2	5
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	71	4	0	71	59	17	88
SIPUNCULA	1	0	0	1	0	0	1
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	28	3	0	28	14	3	31
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	27	2	0	27	15	4	31
HEMICHORDATA	1	1	0	1	0	0	1
CHORDATA-UROCHORDATA	17	3	0	17	13	5	22
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	31	0	0	31	56	39	70
TOTAL	412	44	0	412	290	114	526

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-6. Species collected in at least 9 of 12 dredge samples or 3 of 4 trawl samples from Station 3.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Cystodictyon pavonium	12	3
Halimeda gracilis	6	3
PORIFERA		
Cinachyra alloclada	12	2
Placospongia melobesioides	11	4
Siphonodictyon siphonum	10	0
? Leucosolenia spp.	8	3
Ircinia strobilina	5	3
Dysidea spp.	5	3
CNIDARIA		
Thyroscyphus marginatus	10	2
Stephanoscyphus corniformis	9	2
MOLLUSCA		
Turritella acropora	10	0
T. exoleta	10	0
Corbula dietziana	9	1
Laevicardium pictum	5	3
Calliostoma tampaense	3	3
CRUSTACEA		
Portunus spinicarpus	12	3
Paguristes sericeus	11	0
Phimochirus holthuisi	11	1
Galathea rostrata	10	3
Palicus alternatus	9	2
Dromidia antillensis	8	4
Stenorhynchus seticornis	7	4
Sicyonia brevirostris	6	3
Munida pusilla	5	3
Mithrax (Mithrax) acuticornis	4	4
BRYOZOA		
Steganoporella magnilabris	12	4
Stylopoma spongites	12	4
Bracebridgia subsulcata	11	2
Celleporaria albirostris	7	3
Idmidronea atlantica	7	3
Celleporaria magnifica	6	3

Table 6-6. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ECHINODERMATA		
Ophiothrix angulata	10	3
Arbacia punctulata	9	3
Genocidaris maculata	9	3
Echinaster sp.	2	3
ASCIDIACEA		
Didemnum candidum	11	4
FISHES		
Synodus foetens	0	4
S. poeyi	0	4
Serranus phoebe	1	3
Syacium papillosum	1	3
Synodus intermedius	0	3
Halieutichthys aculeatus	0	3

Table 6-7. Station 3: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer	18.6	4.9 Ascidiacea (4.2 *Didemnum candidum*) 4.4 Chlorophycophyta 3.6 Rhodophycophyta (0.9 *Gracilaria* sp.) 3.0 Porifera 1.4 Cyanophyta
Fall	7.5	4.8 Porifera (1.3 *Placospongia melobesioides*) 2.1 Chlorophycophyta (1.4 *Halimeda* sp.)
Winter	13.1	7.4 Porifera (4.2 *P. melobesioides*) 3.4 Chlorophycophyta (3.0 *Cystodictyon* sp.)
Spring	16.6	7.8 Porifera (2.0 *P. melobesioides*) 3.5 Phaeophycophyta 1.8 Ascidiacea 1.5 Rhodophycophyta

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

6.3.3 Station 7

Physical Features -- Station 7 was located at 26°16.82'N, 82°44.02'W; 70 km from shore. There was little apparent slope across the station. Depths ranged from 30 to 31m. The bottom was covered with a predominantly thick sand substrate, accompanied by lesser coverage of thin sand veneer over hard bottom substrate. Occasional rock outcrops were also present at the site.

Taxonomic Richness & Composition -- At Station 7, 468 taxa (identified to genus or species) were identified (Table 6-8). Predominant groups (listed in order of decreasing numbers of taxa) included Porifera, Crustacea, Gnathostomata (fishes), Gastropoda, and Cnidaria. These groups accounted for 66% of all taxa observed.

Table 6-9 lists some of the most frequently captured taxa from Station 7.

Epibiotal Cover -- Total epibiotal cover varied little seasonally, although the highest value was observed in summer (Table 6-10). Sponges were consistently major contributors to total cover, but their contribution was overwhelmed by brown and green (*Halimeda* sp.) algae during spring and by red, blue-green, and brown (including *Sargassum* sp.) algae during summer. The seasonal abundance patterns of algal groups at this station were somewhat different from those at Stations 1 and 3 in that brown algae were abundant during summer whereas green algae were not. Perennial algae were not as prominent among the frequently collected algae as at Station 3. The sponge contribution appeared to vary inversely with algal cover, again partially reflecting the tendency of algae to overgrow or obscure sponges in the photographs.

6.3.4 Station 9

Physical Features -- Station 9 was located at 26°16.83'N, 83°23.81'W; 126 km from shore. A slight downward slope from east to west was evident across the station block. Depth ranged from 55 to 56m. A thin sand veneer over hard bottom was the predominant substrate, with lesser coverage by a thick sand substrate. Occasional rock outcrops were also present.

Table 6-8. Station 07, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	12	4	0	12	6	1	13
PHAEOPHYCOPHYTA	10	4	0	10	10	5	15
RHODOPHYCOPHYTA	30	2	0	30	10	2	32
ANTHOPHYTA	1	0	0	1	1	0	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	77	16	0	77	48	13	90
CNIDARIA	36	8	0	36	10	2	38
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	47	1	0	47	8	3	50
POLYPLACOPHORA	2	0	0	2	1	0	2
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	26	0	0	26	7	0	26
SCAPHOPODA	3	0	0	3	0	0	3
CEPHALOPODA	3	1	0	3	1	1	4
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	65	1	0	65	41	11	76
SIPUNCULA	1	0	0	1	0	0	1
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	16	1	0	16	11	3	19
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	16	3	0	16	11	1	17
HEMICHORDATA	1	0	0	1	1	0	1
CHORDATA-UROCHORDATA	21	3	0	21	13	4	25
CHORDATA-CEPHALOCHORDATA	1	0	0	1	0	0	1
CHORDATA-GNATHOSTOMATA	25	3	0	25	44	29	57
TOTAL	393	47	0	393	223	75	468

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-9. Species collected in at least 9 of 12 dredge samples or 3 of 4 trawl samples from Station 7.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Halimeda gracilis	10	3
Laurencia intricata	9	3
PORIFERA		
Placospongia melobesioides	12	4
Cinachyra alloclada	12	4
Axinella polycapella	11	4
Homaxinella waltonsmithi	11	4
Timea ? mixta	9	2
Pseudaxinella lunaecharta	9	2
Axinella spp.	8	3
Microciona spp.	6	3
CNIDARIA		
Cladocora arbuscula	10	3
Solenastrea hyades	10	0
Scolymia lacera	10	0
Siderastrea radians	9	0
Oculina diffusa	9	0
MOLLUSCA		
Chione latilirata	9	0
CRUSTACEA		
Portunus ordwayi	9	3
Gonodactylus bredini	9	3
Stenorhynchus seticornis	3	3
BRYOZOA		
Celleporaria albirostris	9	4
ECHINODERMATA		
Ophiolepis elegans	12	4
Ophiothrix angulata	10	2
Encope aberrans	10	0
Lytechinus variegatus carolinas	8	3
Arbacia punctulata	7	3

Table 6-9. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ASCIDIACEA		
Didemnum candidum	10	3
Rhabdopleura compacta	9	2
Clavelina gigantea	8	3
FISHES		
Synodus foetens	0	4
Hippocampus erectus	2	3
Prionotus roseus	0	3
Equetus lanceolatus	0	3

Table 6-10. Station 7: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer	17.7	3.9 Porifera (0.7 *Placospongia melobesioides*)
		2.7 Rhodophycophyta (1.2 *Gracilaria* sp.)
		2.7 Cyanophyta
		2.7 Phaeophycophyta (2.3 *Sargassum vulgare*)
		2.3 Chlorophycophyta
		1.4 Echinoidea (1.3 *Lytechinus variegatus*)
		1.3 Cnidaria (hard corals)
Fall	14.9	8.0 Porifera (2.3 P. *melobesioides*, 1.1 *Cinachyra* spp.)
		3.2 Rhodophycophyta (3.2 Cryptonemiales)
		1.4 Crustacea
		0.8 Chlorophycophyta
Winter	14.3	10.5 Porifera (4.4 P. *melobesioides*, 2.4 *Cinachyra* spp.)
		1.0 Cnidaria (hard corals)
		1.0 Echinoidea (0.9 *Arbacia punctulata*)
		1.0 Ascidiacea (1.0 *Didemnum candidum*)
Spring	15.6	7.3 Fishes**
		5.0 Porifera (1.2 *Cinachyra* spp.)
		2.6 Phaeophycophyta

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Although fishes do not constitute "epibiotal cover," they were so abundant in photographs that they have been included here. If fishes are entirely excluded from the calculation, total biotic cover = 9.0%.

Taxonomic Richness & Composition -- At Station 9, 437 taxa (identified to genus or species) were collected during the entire two-year program (Table 6-11). The predominant groups (listed in order of decreasing numbers of taxa) were Crustacea, Gnathostomata (fishes), Porifera, and Ectoprocta (bryozoans). These contributed about 66% of all taxa identified. Station 9 had the highest number of crustacean and fish taxa (tied with Station 3) of any station.

Table 6-12 lists some of the most frequently captured taxa from Station 9.

Epibiotal Cover -- Total epibiotal cover exhibited moderate seasonal variation, reaching a maximum in summer and a minimum in winter (Table 6-13). Algae were the dominant contributors to total cover during all seasons (Table 6-13). Green (especially *Halimeda* sp.) and red algae dominated during summer; green algae (again, *Halimeda* sp.) generally dominated during fall and winter. *Halimeda* is a perennial that was generally common at mid shelf depths. Only during spring, when the brown algae dominated, was green algal cover apparently low. Only one brown algal species was collected by dredge during spring (*Lobophora variegata*); this suggests that the brown algal cover observed during spring was due to *L. variegata*, although it was not specifically identifiable from the photographs. Sponge and bryozoan cover was also noted at relatively low levels during most seasons. Consistent with the low levels of sponge cover observed, Station 9 supported the lowest number of sponge taxa of all stations (based on dredge and trawl collections).

Additional Remarks -- Station 9 (like Station 3) was located in a relatively small patch of live bottom along Transect B. The predominance of perennial algal (*Halimeda* sp.) cover, the low levels of sponge cover, and the high levels of "thin sand over hard substrate" in contrast to thick sand make the station unique among inner and middle shelf stations.

6.3.5 Station 10

Physical Features -- Station 10 was located at 26°16.73'N, 83°42.81'W; approximately 154 km from shore. Across the station, there was a general downward slope from east to west. This slope was gradual along the eastern two-thirds

Table 6-11. Station 09, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	10	4	0	10	8	2	12
PHAEOPHYCOPHYTA	10	1	0	10	9	1	11
RHODOPHYCOPHYTA	13	5	0	13	18	9	22
ANTHOPHYTA	0	0	0	0	2	2	2
PROTOZOA	1	0	0	1	1	0	1
PORIFERA	28	8	0	28	30	13	41
CNIDARIA	17	1	0	17	14	4	21
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	40	0	0	40	21	7	47
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	23	0	0	23	12	5	28
SCAPHOPODA	2	0	0	2	0	0	2
CEPHALOPODA	3	0	0	3	6	3	6
ARTHROPODA-PYCNOGONIDA	2	0	0	2	2	0	2
ARTHROPODA-MANDIBULATA-CRUSTACEA	81	0	0	81	65	16	97
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	29	5	0	29	28	5	34
BRACHIOPODA	1	0	0	1	0	0	1
ECHINODERMATA	28	5	0	28	20	2	30
HEMICHORDATA	1	0	0	1	1	0	1
CHORDATA-UROCHORDATA	6	4	0	6	7	3	9
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	27	3	0	27	64	43	70
TOTAL	322	36	0	322	308	115	437

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-12. Species collected in at least 9 of 12 dredge samples or 3 of 4 trawl samples from Station 9.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Halimeda gracilis	12	3
Lithothamnium calcareum	7	3
Caulerpa sertularioides	5	3
PORIFERA		
Tethya actinia	4	3
Cinachyra alloclada	1	4
CNIDARIA		
Madracis asperula	9	4
Aglaophenia elongata	7	4
Thyroscyphus marginatus	5	3
Leptogorgia euryale	0	3
MOLLUSCA		
Turritella exoleta	9	0
Nemocardium tinctum	7	3
Vermicularia knorii	5	3
Lima pellucida	4	3
Octopus joubini	4	3
O. vulgaris	1	3
Semirossia equalis	1	3
Loligo plei	0	3
CRUSTACEA		
Paguristes sericeus	9	1
Manucomplanus corallinus	8	4
Dromidia antillensis	7	4
Stenorhynchus seticornis	6	4
Synalpheus townsendi	6	3
Scyllarus chacei	6	3
Munida pusilla	6	3
Carpoporus papulosus	6	3
Pilumnus floridanus	6	3
Stenocionops furcata furcata	4	3
Leptochela carinata	3	3
Solenocera atlantidis	2	3
Podochela lamelligera	2	3
Portunus spinicarpus	2	3
Sicyonia brevirostris	1	3
Galathea rostrata	1	4
Tozeuma serratum	1	3
Meiosquilla quadridens	1	3
Metapenaeopsis goodei	0	3

Table 6-12. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
BRYOZOA		
Stylopoma spongites	12	4
Steganoporella magnilabris	10	4
Amathia convoluta	9	4
Cellaria irregularis	9	3
Hippopetraliella bisinuata	7	3
Celleporaria albirostris	7	3
C. magnifica	6	3
Nellia oculata	5	3
Idmidronea atlantica	5	3
ECHINODERMATA		
Ophiolepis elegans	12	3
Ophiomyxa flaccida	11	4
Eucidaris tribuloides tribuloides	11	4
Echinolampas depressa	10	0
Ophiothrix angulata	9	4
Genocidaris maculata	9	4
Astropecten duplicatus	9	0
Echinaster sp.	6	3
Clypeaster prostratus	6	3
ASCIDIACEA		
Polycarpa obtecta	11	2
Didemnum candidum	10	4
Rhabdopleura compacta	3	3
FISHES		
Rypticus bistrispinus	3	4
Halieutichthys aculeatus	2	4
Monacanthus ciliatus	2	4
Gymnothorax nigromarginatus	1	4
Trachinocephalus myops	1	4
Bothus robinsi	1	4
Syacium papillosum	1	4
Synodus intermedius	0	4
Scorpaena inermis	2	3
Prionotus roseus	2	3
Antennarius ocellatus	0	3
Scorpaena agassizii	0	3
S. brasiliensis	0	3
Centropristis ocyurus	0	3
Serranus phoebe	0	3
Sphoeroides dorsalis	0	3

Table 6-13. Station 9: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover	
	All Epibiota	Major Contributors*
Summer	18.8	8.6 Chlorophycophyta (4.3 *Halimeda* sp.) 3.6 Rhodophycophyta (1.0 *Lithothamnium* sp., 0.5 *Peyssonnelia* sp.) 2.4 Ectoprocta 1.2 Porifera 1.2 Crustacea (galatheid crabs)
Fall	16.3	12.1 Chlorophycophyta (9.4 *Halimeda* sp.) 1.8 Phaeophycophyta 1.1 Rhodophycophyta (0.8 Cryptonemiales) 0.8 Ectoprocta (cheilostomes)
Winter	13.2	6.7 Chlorophycophyta (5.3 *Halimeda* sp.) 2.8 Ectoprocta (1.0 *Steganoporella magnilabris*) 1.5 Echinodermata (echinoids)
Spring	14.6	5.7 Phaeophycophyta 4.3 Chlorophycophyta (3.9 *Halimeda* sp.) 1.9 Porifera 1.1 Rhodophycophyta (0.9 Cryptonemiales) 0.9 Ectoprocta

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

of the station block (70 to 72m depths). An abrupt drop from 72 to 76m was evident in the western third of the block. The bottom was a nearly equal mixture of thick sand and thin sand veneer substrates. A few exposed rock outcrops were also observed.

Taxonomic Richness & Composition -- A total of 326 taxa (identified to genus or species) were collected at Station 10 (Table 6-14). Predominant groups (listed in order of decreasing numbers of taxa) included Porifera, Crustacea, Gnathostomata (fishes), Gastropoda, and Echinodermata (sea urchins, ophiuroids, starfish, etc.). Collectively, these groups accounted for 75% of all taxa observed.

Table 6-15 lists some of the most frequently captured taxa from Station 10.

Epibiotal Cover -- Because this station was sampled only during fall and spring, it is difficult to evaluate any seasonal trends. However, total cover was twice as high during spring as during fall (Table 6-16), primarily reflecting the bloom of (unidentified) brown algae during spring, a feature observed at several other stations. Red algal cover consisted mostly of crustose red algae in the order Cryptonemiales (*Peyssonnelia rubra*, *P. simulans*, *Lithothamnium* spp., and others) that can be expected to exhibit less seasonality than other rhodophytes (one might expect to see a bloom of other red algae during summer at this station). The higher sponge cover observed during spring is difficult to interpret, especially considering the higher algal abundance during that period. The results could reflect intra-station variability, decreased masking of sponge cover by algae, or an actual increase in sponge abundance over the six-month interval.

6.3.6 Station 11

Physical Features -- Station 11 was located at 26°16.72'N, 83°46.82'W; approximately 159 km from shore. Across the station block, there was a downward slope from east to west. The eastern three-fourths of the block had a gradual slope. A sharp drop-off was observed in the western quarter of the block. Rough rock outcrops were prominent along this break, which ran north-south. Depths across

Table 6-14. Station 10, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	4	2	0	4	6	2	6
PHAEOPHYCOPHYTA	1	0	0	1	1	1	2
RHODOPHYCOPHYTA	10	2	0	10	7	2	12
ANTHOPHYTA	0	0	0	0	1	1	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	61	10	0	61	50	21	82
CNIDARIA	18	0	0	18	16	5	23
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	14	0	0	14	19	15	29
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	5	0	0	5	1	0	5
SCAPHOPODA	2	0	0	2	0	0	2
CEPHALOPODA	1	0	0	1	3	2	3
ARTHROPODA-PYCNOGONIDA	0	0	0	0	2	2	2
ARTHROPODA-MANDIBULATA-CRUSTACEA	51	1	0	51	51	20	71
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	15	0	0	15	14	4	19
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	23	0	0	23	13	3	26
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	6	1	0	6	3	2	8
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	17	1	0	17	31	18	35
TOTAL	228	17	0	228	218	98	326

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-15. Species collected in at least 5 of 7 dredge samples or both trawl samples from Station 10.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Peyssonnelia rubra	6	2
Halimeda gracilis	4	2
Lithothamnium ruptile	4	2
PORIFERA		
? *Bubaris* spp.	6	2
Geodia neptuni	5	2
Ircinia strobilina	5	1
Placospongia melobesioides	5	1
Epipolasis spp.	5	0
? *Forcepia* sp.	4	2
Microciona spp.	4	2
Dysidea spp.	2	2
Cinachyra alloclada	2	2
? *Xestospongia* sp.	0	2
CNIDARIA		
Stephanoscyphus corniformis	6	2
Madracis asperula	4	2
MOLLUSCA		
Vermicularia spirata	2	2
CRUSTACEA		
Dardanus insignis	6	0
Phimochirus holthuisi	5	2
Munida pusilla	5	2
Osachila tuberosa	4	2
Macrocoeloma septemspinosum	3	2
Parthenope fraterculus	3	2
Scyllarus chacei	2	2
Paguristes hernancortezi	2	2
Podochela lamelligera	2	2
Parthenope agona	2	2
Portunus spinicarpus	2	2
Dromidia antillensis	1	2
Podochela gracilipes	1	2
Stenorhynchus seticornis	1	2
Ethusa tenuipes	0	2
BRYOZOA		
Steganoporella magnilabris	4	2
Celleporaria magnifica	2	2

Table 6-15. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ECHINODERMATA		
Ophiothrix angulata	7	2
Stylocidaris affinis	7	2
Ophiomyxa flaccida	5	1
Ophiolepis elegans	4	2
Tosia parva	3	2
Narcissia trigonaria	1	2
ASCIDIACEA		
Didemnum candidum	7	2
FISHES		
Halieutichthys aculeatus	2	2
Prionotus alatus	2	2
Hippocampus erectus	1	2
Scorpaena agassizii	1	2
S. dispar	1	2
Serranus notospilus	1	2
Rypticus bistrispinus	1	2
Gymnothorax nigromarginatus	0	2
Synodus poeyi	0	2
Adioryx bullisi	0	2
Serranus phoebe	0	2
Sphoeroides spengleri	0	2

Table 6-16. Station 10: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover	
	All Epibiota	Major Contributors*
Summer**	-	-
Fall	11.3	5.9 Rhodophycophyta (2.1 Cryptonemiales, 1.6 *Peyssonnelia simulans*, 0.9 *P. rubra*) 2.8 Chlorophycophyta (1.3 *Halimeda* sp.) 2.1 Porifera
Winter**	-	-
Spring	22.2	7.2 Phaeophycophyta 7.4 Porifera (0.7 *Cinachyra* spp.) 6.0 Rhodophycophyta (2.3 *P. simulans*, 2.2 *P. rubra*, 1.3 Cryptonemiales)

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

** Station 10 was only sampled on the Fall and Spring Cruises.

the station ranged from 77 to 84m. Bottom substrates at this site were dominated by thick sand and coralline algal nodule areas.

Taxonomic Richness & Composition -- At Station 11, 399 taxa (identified to genus or species) were collected throughout the program (Table 6-17). Predominant groups (listed in order of decreasing numbers of taxa) included Porifera, Crustacea, Gnathostomata (fishes), Cnidaria, and Echinodermata. These contributed 71% of the taxa identified.

Table 6-18 lists some of the most frequently captured taxa from Station 11.

Epibiotal Cover -- Cover varied seasonally, but was highest in summer and lowest in spring (Table 6-19). Algae were the primary contributors to percent cover during all seasons except winter, when sponge cover predominated. Most of this sponge cover was unidentifiable, in contrast to results at some shallower stations; this reflects a predominance of relatively uncommon or unusual forms that were not identified to genus or species even in dredge and trawl samples. Red cryptonemialid algae were fairly abundant during all seasons, though most abundant in summer and least in winter. Levels of perennial red algal cover were, in general, similar to those observed at Station 10 and much lower than those noted at more southerly stations in the same depth range. As observed at most of the mid to outer shelf stations, brown algal contribution to cover was minimal.

6.3.7 Station 13

Physical Features -- Station 13 was located at 25°45.93'N, 82°09.35'W; approximately 51 km from shore. Depths across the station ranged from 19.5 to 20.0m. However, a slight downward slope from ENE to WSW was indicated. Occasional depressions (about 0.3m deep) were observed along the bottom. Thick sand and thin sand veneer (over hard bottom) substrates dominated at this location. A few rock outcrops were also noted.

Taxonomic Richness & Composition -- Collections yielded 434 benthic taxa (identified to genus or species) at Station 13 (Table 6-20). Five major faunal

Table 6-17. Station 11, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	4	1	0	4	4	1	5
PHAEOPHYCOPHYTA	3	1	0	3	4	2	5
RHODOPHYCOPHYTA	14	4	0	14	11	6	20
ANTHOPHYTA	0	0	0	0	1	1	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	81	14	0	81	47	14	95
CNIDARIA	30	2	0	30	15	5	35
ANNELIDA	0	1	1	1	0	0	1
GASTROPODA	23	0	0	23	8	3	26
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	11	0	0	11	2	1	12
SCAPHOPODA	1	0	0	1	0	0	1
CEPHALOPODA	4	0	0	4	9	7	11
ARTHROPODA-PYCNOGONIDA	1	0	0	1	2	1	2
ARTHROPODA-MANDIBULATA-CRUSTACEA	66	1	0	66	40	9	75
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	18	1	0	18	8	5	23
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	25	1	0	25	15	6	31
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	7	2	0	7	6	1	8
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	16	0	0	16	42	32	48
TOTAL	304	28	1	305	212	94	399

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-18. Species collected in at least 9 of 12 dredge samples or 3 of 4 trawl samples from Station 11.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species: Dredge	Trawl
ALGAE		
Maripelta atlantica	7	4
Peyssonnelia rubra	7	3
PORIFERA		
Geodia neptuni	10	4
Ircinia strobilina	10	2
Placospongia melobesioides	9	2
? *Jaspis* spp.	9	2
Dysidea spp.	7	4
Discodermia sp.	6	3
Myriastra ? *crassispicula*	3	3
Xestospongia subtriangularis	1	3
CNIDARIA		
Madracis asperula	8	3
CRUSTACEA		
Parthenope fraterculus	12	4
Micropanope sculptipes	9	2
Osachila tuberosa	9	1
Munida pusilla	7	3
Iliacantha subglobosa	7	3
Podochela lamelligera	6	4
Portunus spinicarpus	6	4
Scyllarus depressus	4	4
Stenorhynchus seticornis	4	4
Mesopenaeus tropicalis	0	3
BRYOZOA		
Steganoporella magnilabris	3	4
Amathia convoluta	0	3
ECHINODERMATA		
Ophiomyxa flaccida	12	3
Stylocidaris affinis	11	3
Ophiothrix angulata	10	4
Echinaster sp.	0	3
ASCIDIACEA		
Didemnum candidum	10	4

Table 6-18. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
FISHES		
Synodus intermedius	0	4
Serranus notospilus	0	4
Serranus phoebe	0	4
Monacanthus ciliatus	0	4
Hippocampus erectus	3	3
Gymnothorax nigromarginatus	0	3
Synodus poeyi	0	3
Porichthys plectrodon	0	3

Table 6-19. Station 11: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover	
	All Epibiota	Major Contributors*
Summer	31.4	14.4 Chlorophycophyta 9.0 Rhodophycophyta (3.4 _Peyssonelia rubra_, 1.4 _P. simulans_, 1.2 Cryptonemiales, 0.6 _Gracilaria_ sp.) 6.5 Porifera
Fall	13.2	7.9 Rhodophycophyta (2.0 Cryptonemiales, 1.8 _P. simulans_, 1.0 _P. rubra_) 2.8 Chlorophycophyta 1.6 Porifera
Winter	15.2	12.3 Porifera 2.3 Rhodophycophyta (1.0 _P. rubra_, 0.3 _P. simulans_, 0.8 Corallinaceae)
Spring	7.2	4.2 Rhodophycophyta (3.3 _P. simulans_. 0.9 _P. rubra_) 1.8 Porifera 0.9 Cnidaria (0.7 Hydrozoa)

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

Table 6-20. Station 13, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	16	3	0	16	7	2	18
PHAEOPHYCOPHYTA	8	1	0	8	5	3	11
RHODOPHYCOPHYTA	20	2	0	20	4	0	20
ANTHOPHYTA	1	0	0	1	1	0	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	58	30	0	58	22	6	64
CNIDARIA	29	6	0	29	15	4	33
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	44	2	0	44	6	4	48
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	31	0	0	31	6	0	31
SCAPHOPODA	3	0	0	3	0	0	3
CEPHALOPODA	0	0	0	0	0	0	0
ARTHROPODA-PYCNOGONIDA	1	0	0	1	0	0	1
ARTHROPODA-MANDIBULATA-CRUSTACEA	72	1	0	72	38	7	79
SIPUNCULA	1	0	0	1	0	0	1
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	15	0	0	15	9	2	17
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	29	4	0	29	14	1	30
HEMICHORDATA	1	0	0	1	1	0	1
CHORDATA-UROCHORDATA	17	1	0	17	6	2	19
CHORDATA-CEPHALOCHORDATA	1	0	0	1	0	0	1
CHORDATA-GNATHOSTOMATA	29	2	0	29	41	27	56
TOTAL	376	52	0	376	175	58	[illegible]

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

groups contributed 65% of the taxa identified. Listed in order of decreasing numbers of taxa, these were Crustacea, Porifera, Gnathostomata (fishes), Gastropoda, and Cnidaria.

Table 6-21 lists some of the most frequently captured taxa from Station 13.

Epibiotal Cover -- Total percent cover changed little seasonally except during summer, when a bloom of blue-green algae dominated (Table 6-22). However, the relative constancy of total cover for the remaining seasons may be fortuitous considering the apparent changes in relative abundance of various groups. Green algal abundance varied in a predictable manner, reaching a maximum during summer and fall. Likewise, red algal cover reached a maximum in summer, a finding consistent with results at other shallow stations. However, brown algae were most abundant during fall and winter, not spring as at most other shallow stations. Sponges constituted a greater portion of total cover during winter and spring than in summer and fall, possibly reflecting in part the reduced abundance of algae that might have masked them at other times. An unusual and distinctive feature of Station 13 was the high abundance of several gorgonians (e.g., *Pseudoplexaura* spp., *Eunicea* spp., *Plexaurella* spp., *Muricea elongata*, *Lophogorgia* spp., *Pseudopterogorgia* spp.) in the families Plexauridae and Gorgoniidae (not separately identifiable to species from photographs). However, their apparent abundance varied widely between seasons, probably reflecting their patchy distribution and the difficulty of estimating the percent cover represented by their erect, branching forms. Hydroids were also especially abundant during spring at this station.

It is impossible to determine with only one year of data whether the blue-green algal bloom in summer is unique and characteristic, or indicative of some disturbance; filamentous cyanophyte blooms have been observed following red tide outbreaks at shallower (<20m depths) live bottom areas (Smith, 1975).

Additional Remarks -- The abundance and variety of gorgonians noted at Station 13 was unique among stations sampled during Years One and Two. However, gorgonian-dominated assemblages are common at shallower live bottom locations surveyed during Year Three of this study.

Table 6-21. Species collected in at least 9 of 12 dredge samples or 3 of 4 trawl samples from Station 13.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
PORIFERA		
Anthosigmella varians	12	3
Geodia gibberosa	11	3
Haliclona compressa	5	3
CNIDARIA		
Pseudopterogorgia acerosa	9	4
MOLLUSCA		
Laevicardium pictum	9	3
Strombus costatus	9	1
Macrocallista maculata	9	0
CRUSTACEA		
Pilumnus sayi	11	4
Sicyonia typica	9	1
Paguristes punticeps	9	1
Stenorhynchus seticornis	8	3
Mithrax (Mithrax) pleuracanthus	7	4
Scyllarus americanus	7	3
Lobopilumnus agassizii	6	3
Petrolisthes galathinus	5	3
Macrocoeloma camptocerum	5	3
Podochela riisei	5	3
Paguristes tortugae	4	3
BRYOZOA		
Cupuladria biporosa	9	1
Celleporaria albirostris	8	1
Nellia oculata	7	3
ECHINODERMATA		
Ophiolepis elegans	9	1
FISHES		
Serranus subligarius	2	4
Monacanthus ciliatus	3	3
Lactophrys quadricornis	2	3
Diplectrum formosum	0	3

Table 6-22. Station 13: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer	60.2	45.8 Cyanophyta 6.8 Chlorophycophyta 3.0 Cnidaria (2.8 Gorgonacea including 2.3 Gorgoniidae and 0.5 Plexauridae**) 2.5 Rhodophycophyta (1.1 Gracilaria sp.) 1.7 Porifera
Fall	18.7	6.3 Cnidaria (5.8 Gorgonacea) 5.8 Phaeophycophyta 3.2 Chlorophycophyta (2.3 Caulerpa sp.) 2.6 Porifera
Winter	22.2	12.7 Cnidaria (12.5 Gorgonacea including 11.4 Gorgoniidae and 1.1 Plexauridae) 5.9 Porifera (2.6 Spheciospongia sp.) 2.0 Phaeophycophyta (0.8 Sargassum sp.) 1.1 Ophiuroidea
Spring	22.0	10.4 Porifera (1.6 Geodia gibberosa) 10.0 Cnidaria (8.1 Hydrozoa, 1.7 Gorgonacea) 0.8 Phaeophycophyta

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Gorgonians were identified as Gorgonacea during Year One (Fall and Spring Cruises) but the families Gorgoniidae and Plexauridae were distinguished during Year Two (Summer and Winter Cruises).

6.3.8 Station 15

Physical Features -- Station 15 was located at 25°45.89'N, 82°31.62'W; approximately 82 km from shore. No general slope was evident across the station block. Depths ranged from 31 to 32m. Occasional depressions (about 0.3m deep) were noted. Thin sand veneer (over hard bottom) and thick sand substrates predominated at Station 15. Rock outcrops were also present in some areas.

Taxonomic Richness & Composition -- At Station 15, 417 benthic taxa (identified to genus or species) were collected throughout the program (Table 6-23). Six major faunal groups contributed 79% of the taxa identified. Listed in order of decreasing numbers of taxa, these were Porifera, Crustacea, Gastropoda, Gnathostomata (fishes), Bivalvia, and Cnidaria. Station 15 had a very high number of sponge species (second only to Station 21).

Table 6-24 lists some of the most frequently captured taxa from Station 15.

Epibiotal Cover -- Total epibiotal cover was highest during summer and lowest during fall and spring (Table 6-25). Sponges dominated during all seasons except summer, when blooms of red (*Gracilaria* sp. and others) and green algae dominated. Brown algae were never very abundant at this station, although *Rosenvingea intricata* contributed significantly to total cover during summer (in fact, this was the only phaeophyte collected in dredge samples at the station).

Additional Remarks -- Station 15 supported an extraordinarily large number of sponge species (second only to Station 21) and those sponges dominated cover at the station (also a feature of Station 21). It is interesting to note that the coral *Agaricia* sp., which was otherwise restricted to stations in the southwest corner of the study area (especially Station 29), contributed some small amounts of cover (<1%) on several cruises and *A. fragilis* was collected in several dredge samples at the station. The long-spined sea urchin *Diadema antillarum*, which also was abundant only at Station 29, was captured in one dredge sample from this station.

Table 6-23. Station 15, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	9	4	0	9	7	3	12
PHAEOPHYCOPHYTA	1	1	0	1	3	2	3
RHODOPHYCOPHYTA	16	3	0	16	7	2	18
ANTHOPHYTA	0	0	0	0	1	1	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	103	48	0	103	51	5	108
CNIDARIA	23	12	0	23	11	2	25
ANNELIDA	0	1	1	1	0	0	1
GASTROPODA	40	1	0	40	17	7	47
POLYPLACOPHORA	1	0	0	1	0	0	1
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	25	0	0	25	7	2	27
SCAPHOPODA	1	0	0	1	0	0	1
CEPHALOPODA	0	0	0	0	1	1	1
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	72	2	0	72	38	7	79
SIPUNCULA	1	0	0	1	0	0	1
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	15	0	0	15	7	1	16
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	17	4	0	17	7	1	18
HEMICHORDATA	1	0	0	1	1	0	1
CHORDATA-UROCHORDATA	11	3	0	11	5	2	13
CHORDATA-CEPHALOCHORDATA	1	0	0	1	0	0	1
CHORDATA-GNATHOSTOMATA	26	2	0	26	32	17	43
TOTAL	363	81	1	364	195	53	417

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-24. Species collected in at least 9 of 12 dredge samples or 3 of 4 trawl samples from Station 15.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Codium isthomocladum	3	3
PORIFERA		
Niphates erecta	11	4
Anthosigmella varians	11	4
Geodia gibberosa	11	3
Placospongia melobesioides	11	3
Aplysina fistularis v. *fulva*	10	3
Cinachyra alloclada	10	3
? *Dysidea* spp.	10	2
Spirastrella coccinea	10	2
Aiolochroia crassa	9	4
Neofibularia nolitangere	8	3
Ircinia strobilina	5	3
Spinosella plicifera	5	3
Ircinia felix	3	3
Scolopes megastra	2	3
CNIDARIA		
Scolymia lacera	11	1
Cladocora arbuscula	9	2
MOLLUSCA		
Chama macerophylla	9	1
Chicoreus florifer	2	3
CRUSTACEA		
Mithrax (Mithrax) pleuracanthus	12	4
Dromidia antillensis	11	3
Gonodactylus bredini	11	3
Mithrax (Mithraculus) forceps	9	3
Stenorhynchus seticornis	5	4
BRYOZOA		
Celleporaria albirostris	10	3
Amathia convoluta	9	3
Ciglisula cf. *turrita*	9	0
ECHINODERMATA		
Ophiothrix angulata	6	3

Table 6-24. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
FISHES		
Synodus intermedius	0	4
Epinephelus morio	2	3
Rypticus bistrispinus	1	3
Syacium papillosum	1	3
Monacanthus ciliatus	1	3

Table 6-25. Station 15: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer	49.5	18.5 Chlorophycophyta 14.0 Rhodophycophyta (7.8 *Gracilaria* sp.) 12.5 Porifera (1.5 *Placospongia melobesioides*, several others) 2.0 Phaeophycophyta (2.0 *Rosenvingea intricata*) 1.1 Cyanophyta
Fall	19.2	14.6 Porifera (2.6 *P. melobesioides*, 1.4 *Geodia gibberosa*, 1.4 *Ircinia campana*, 1.4 *Hippospongia lachne*, 1.2 *Cinachyra* spp.) 2.2 Chlorophycophyta (2.2 *Halimeda* sp.) 1.4 Cnidaria (hard corals) 0.9 Rhodophycophyta (0.7 Cryptonemiales)
Winter	29.5	23.4 Porifera (3.5 *P. melobesioides*, 2.3 *Cinachyra* spp., 1.9 *Xestospongia* spp., 1.2 *Ircinia campana*, 1.2 *Geodia gibberosa*) 4.6 Cnidaria (mostly hard corals)
Spring	19.8	15.8 Porifera (2.1 *Placospongia* sp., 1.3 *Ircinia campana*, 1.2 *Geodia gibberosa*, 1.2 *Cinachyra* spp.) 2.2 Rhodophycophyta

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

6.3.9 Station 17

Physical Features -- Station 17 was located at 25°45.58'N, 83°20.24'W; approximately 150 km from shore. Across the station, a slight downward slope was observed from east to west. However, depths ranged only from 58 to 59m. The bottom was composed primarily of a thick sand substrate, with lesser coverages of thin sand veneer (over hard bottom) substrate. No exposed rock outcrops were observed at this location.

Taxonomic Richness & Composition -- Benthic biological collections yielded 353 taxa (identified to genus or species) at Station 17 (Table 6-26). Predominant major groups (listed in order of decreasing numbers of taxa) included Porifera, Crustacea, Gastropoda, Gnathostomata (fishes), Ectoprocta, and Echinodermata. Collectively, these groups accounted for 80% of the taxa observed.

Table 6-27 lists some of the most frequently captured taxa from Station 17.

Epibiotal Cover -- Total epibiotal cover was twice as high in fall as in spring, primarily reflecting the elevated abundance of green algae (including *Halimeda* sp. and *Caulerpa* sp.) in fall (Table 6-28). Sponges and cheilostome bryozoans contributed significantly to total cover during both seasons, and probably dominated during winter as well. One would expect green (*Halimeda*, *Caulerpa*) and red algae to predominate in summer.

Additional Remarks -- Station 17, like Stations 3 and 9, was located in a relatively small patch of live bottom too small to appear on shelfwide assemblage maps. The contribution of the perennial *Halimeda* sp., even though predominately occurring in one seasonal survey, was generally characteristic of several mid shelf stations (9, 17, 23).

6.3.10 Station 19

Physical Features -- Station 19 was located at 25°17.36'N, 82°09.00'W; approximately 84 km from shore. No general slope was indicated across the station

Table 6-26. Station 17, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	5	2	0	5	4	0	5
PHAEOPHYCOPHYTA	3	0	0	3	3	0	3
RHODOPHYCOPHYTA	10	0	0	10	3	0	10
ANTHOPHYTA	1	0	0	1	1	0	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	51	2	0	51	41	19	70
CNIDARIA	13	0	0	13	10	2	15
ANNELIDA	0	1	1	1	0	0	1
GASTROPODA	41	0	0	41	9	5	46
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	16	0	0	16	5	1	17
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	4	0	0	4	2	1	5
ARTHROPODA-PYCNOGONIDA	2	0	0	2	2	0	2
ARTHROPODA-MANDIBULATA-CRUSTACEA	59	0	0	59	26	10	69
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	25	0	0	25	19	3	28
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	23	1	0	23	16	4	27
HEMICHORDATA	1	0	0	1	1	0	1
CHORDATA-UROCHORDATA	7	1	0	7	7	2	9
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	25	1	0	25	33	19	44
TOTAL	286	8	1	287	182	66	353

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-27. Species collected in at least 4 of 6 dredge samples or both trawl samples from Station 17.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species: Dredge	Trawl
ALGAE		
Caulerpa sertularioides	6	1
Halimeda gracilis	6	1
PORIFERA		
Cinachyra alloclada	6	2
Ircinia strobilina	4	1
Geodia neptuni	4	1
Dysidea spp.	2	2
Neofibularia nolitangere	2	2
Spirastrella coccinea	2	2
? Erylus spp.	1	2
CNIDARIA		
Oculina tenella	5	1
Thyroscyphus marginatus	4	2
Sertularella pinnigera	4	1
Dynamena pourtalesi	4	1
Aglaophenia elongata	4	1
Madracis asperula	4	1
MOLLUSCA		
Aequipecten muscosus	6	1
Turritella exoleta	6	0
T. acropora	5	1
Laevicardium pictum	5	0
Oliva circinata	4	1
Cymatium krebsii	4	0
Nemocardium tinctum	4	0
Chlamys benedicti	3	2
Hiatella arctica	3	2
Octopus vulgaris	0	2
CRUSTACEA		
Galathea rostrata	6	2
Munida pusilla	5	1
Callidactylus asper	5	1
Stenocionops furcata furcata	5	1
Parthenope agona	5	0
Stenorhynchus seticornis	4	2
Munida angulata	4	1
Carpoporus papulosus	4	1
Manucomplanus corallinus	4	0
Symethis variolosa	4	0

Table 6-27. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
CRUSTACEA (Continued)		
Portunus spinicarpus	4	0
Phimochirus holthuisi	3	2
Synalpheus townsendi	2	2
Stenopus scutellatus	0	2
BRYOZOA		
Stylopoma spongites	6	2
Celleporaria albirostris	6	2
Bugula neritina	6	1
Bacebridgia subsulcata	6	1
Steganoporella magnilabris	5	2
Cellaria irregularis	5	2
Celleporaria magnifica	5	1
Nellia oculata	4	1
Hippoporidra edax	4	0
ECHINODERMATA		
Ophiomyxa flaccida	6	2
Ophiolepis elegans	6	1
Ophiothrix angulata	5	2
Eucidaris tribuloides tribuloides	5	1
Astropecten duplicatus	5	0
Echinaster sp.	5	0
Echinolampas depressa	5	0
Narcissia trigonaria	3	2
Arbacia punctulata	3	2
ASCIDIACEA		
Didemnum candidum	6	2
Polycarpa obtecta	5	1
FISHES		
Monacanthus ciliatus	3	2
Hippocampus erectus	2	2
Serranus notospilus	2	2
Syacium papillosum	2	2
Synodus poeyi	1	2
Serranus phoebe	1	2
Synodus intermedius	0	2
Saurida brasiliensis	0	2
Prionotus roseus	0	2
Centropristis ocyurus	0	2

Table 6-28. Station 17: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer**	-	-
Fall	16.1	8.8 Chlorophycophyta (4.6 _Halimeda_ sp., 3.1 _Caulerpa_ sp.) 3.6 Ectoprocta (cheilostomata) 1.8 Porifera 1.5 Rhodophycophyta
Winter**	-	-
Spring	8.5	3.0 Porifera 1.7 Phaeophycophyta 1.6 Chlorophycophyta (0.6 _Halimeda_ sp., 0.7 _Caulerpa_ sp.) 1.0 Ectoprocta

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Station 17 was sampled only on the Fall and Spring Cruises.

block. Depths ranged from 22 to 23m. Bottom substrate was primarily thick sand, accompanied by lesser coverages of thin sand veneer over hard bottom. No exposed rock outcrops were observed at this location.

Taxonomic Richness & Composition -- Collections yielded 277 benthic taxa (identified to genus or species) at Station 19 (Table 6-29). Five major fauna groups contributed 70% of the taxa identified. Listed in order of decreasing numbers of taxa, these were Crustacea, Porifera, Gnathostomata (fishes), Echinodermata, and Gastropoda.

Table 6-30 lists some of the most frequently captured taxa from Station 19.

Epibiotal Cover -- Total epibiotal cover was somewhat higher during fall than spring and was dominated by sponges (especially *Geodia gibberosa*) during both seasons (Table 6-31). Green algae (*Caulerpa* sp.) were abundant (Table 6-31) during fall; red algae were not abundant on either sampling date. Both are likely to have been abundant during summer, when the station was not sampled. Gorgonians contributed significantly to total cover but were far less abundant than at Station 13; only two of the 12 gorgonian species collected at Station 13 were also collected at Station 19.

Additional Remarks -- Although Station 19 was dominated by sponge cover (as observed at Stations 15 and 21), one species, *Geodia gibberosa*, contributed by far the largest share, in contrast to the large variety of sponge species contributing at other sponge-dominated stations (15 and 21, for example).

6.3.11 Station 21

Physical Features -- Station 21 was located at 25°17.26'N, 82°52.16'W; approximately 140 km from shore. Depths ranged from 44 and 45m across the station block, showing a slight downward slope from east to west. The bottom substrate was primarily composed of a thin sand veneer overlying hard substrate. Lesser coverages of thick sand bottom substrate and occasional rock outcrops were also observed at this location.

Table 6-29. Station 19, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	9	2	0	9	5	1	10
PHAEOPHYCOPHYTA	3	0	0	3	5	2	5
RHODOPHYCOPHYTA	8	0	0	8	4	1	9
ANTHOPHYTA	1	0	0	1	4	3	4
PROTOZOA	1	0	0	1	0	0	1
PORIFERA	36	12	0	36	15	6	42
CNIDARIA	13	2	0	13	8	3	16
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	26	0	0	26	5	1	27
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	16	0	0	16	3	0	16
SCAPHOPODA	1	0	0	1	0	0	1
CEPHALOPODA	0	0	0	0	3	3	3
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	52	1	0	52	30	7	59
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	12	0	0	12	6	2	14
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	24	2	0	24	12	3	27
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	3	1	0	3	1	1	4
CHORDATA-CEPHALOCHORDATA	1	0	0	1	0	0	1
CHORDATA-GNATHOSTOMATA	18	1	0	18	29	20	38
TOTAL	224	21	0	224	130	53	277

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-30. Species collected in at least 4 of 6 dredge samples or both trawl samples from Station 19.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Lithothamium calcareum	5	2
Halimeda gracilis	4	1
Anadyomene menziesii	0	2
PORIFERA		
Anthosigmella varians	6	2
Haliclona compressa	5	2
Geodia gibberosa	5	1
Placospongia melobesioides	1	2
CNIDARIA		
Sertularella pinnigera	4	1
MOLLUSCA		
Laevicardium pictum	6	1
L. laevigatum	5	0
Periglypta listeri	5	0
Diodora cayenensis	4	1
Strombus costatus	4	1
Oliva circinata	4	0
Strioterebrum onslowensis	4	0
Tellina listeri	4	0
Macrocallista maculata	4	0
CRUSTACEA		
Petrolisthes galathinus	5	2
Pilumnus sayi	5	2
Albunea gibbesi	5	0
Paguristes sericeus	5	0
Mithrax (Mithrax) pleuracanthus	4	2
Stenorhynchus seticornis	4	2
Pilumnus dasypodus	4	2
Paguristes punticeps	4	1
Gonodactylus bredini	4	0
Dromidia antillensis	1	2
ECHINODERMATA		
Ophiolepis elegans	6	2
Astropecten duplicatus	4	1
Thyonella pervicax	4	0
Oreaster reticulatus	2	2
Echinaster sp.	1	2

Table 6-30. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
FISHES		
Scorpaena brasiliensis	3	2
Monacanthus ciliatus	2	2
Diplectrum formosum	1	2
Lactophrys quadricornis	1	2
Synodus foetens	0	2
Syacium papillosum	0	2

Table 6-31. Station 19: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer**	-	-
Fall	19.5	14.4 Porifera (7.8 <u>Geodia gibberosa</u>, 1.2 <u>Ircinia ? strobilina</u>) 3.1 Chlorophycophyta (3.1 <u>Caulerpa</u> sp.) 0.8 Cnidaria (0.7 Gorgonacea) 0.7 Phaeophycophyta
Winter**	-	-
Spring	13.7	11.2 Porifera (7.0 <u>Geodia gibberosa</u>) 1.6 Cnidaria (1.4 Gorgonacea)

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Station 19 was sampled only on the Fall and Spring Cruises.

Taxonomic Richness & Composition -- Benthic biological collections yielded 466 taxa (identified to genus or species) at Station 21 (Table 6-32). Six major groups accounted for 79% of the taxa identified. Listed in order of decreasing numbers of taxa, these groups were Porifera, Crustacea, Gnathostomata (fishes), Gastropoda, Rhodophycophyta, and Bivalvia. Station 21 supported the largest number of sponge species of any station.

Table 6-33 lists some of the most frequently captured taxa from Station 21.

Epibiotal Cover -- Total epibiotal cover remained fairly consistent seasonally, with the exception of a large increase during summer, attributable to blooms of red and green algae (Table 6-34). Sponges dominated epibiotal cover in all other seasons, with lesser abundances of green, red, and brown algal contributing. Ascidians (*Didemnum candidum*) were abundant during summer, although several species were present year-round.

Relatively few algal taxa were present during summer when the red and green algal blooms occurred, and several of these occurred year-round at the station. Green algae collected during summer included *Caulerpa sertularioides*, *Halimeda gracilis*, *Udotea conglutinata*, and *Cystodictyon pavonium*; red algae included *Gracilaria* spp., *Peyssonnelia simulans*, *Lithophyllum pustulatum*, and *Agardhiella subulata*.

Additional Remarks -- Station 21 supported an extraordinarily large number of sponge species and sponge cover was dominant during most seasons, features that it holds in common with Station 15. The hard coral *Agaricia fragilis*, which was generally restricted to Stations 29 and 30, also occurred in one dredge sample here.

6.3.12 Station 23

Physical Features -- Station 23 was located at 25°16.89'N, 83°37.79'W; 208 km from shore. Depths across the station ranged from 70 to 73m. A variable slope, upward from the station center to both the east and west, was indicated. Numerous small-scale elevations and depressions extended through the station

Table 6-32. Station 21, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	10	4	0	10	4	1	11
PHAEOPHYCOPHYTA	8	2	0	8	3	0	8
RHODOPHYCOPHYTA	23	5	0	23	9	4	27
ANTHOPHYTA	1	0	0	1	0	0	1
PROTOZOA	1	0	0	1	0	0	1
PORIFERA	123	36	0	123	43	5	128
CNIDARIA	19	2	0	19	2	0	19
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	39	0	0	39	11	4	43
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	24	0	0	24	8	1	25
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	1	0	0	1	2	1	2
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	77	1	0	77	37	9	86
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	15	2	0	15	8	1	16
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	17	2	0	17	10	3	20
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	18	3	0	18	11	2	20
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	26	2	0	26	46	33	59
TOTAL	402	59	0	402	194	64	466

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-33. Species collected in at least 9 of 12 dredge samples or 2 of 3 trawl samples from Station 21.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Cystodictyon pavonium	12	3
Halimeda gracilis	9	0
Gracilaria mammillaris	3	2
Agardhiella subulata	1	2
PORIFERA		
Ircinia strobilina	12	3
Placospongia melobesioides	12	3
Geodia gibberosa	12	3
Anthosigmella varians	12	1
Cinachyra alloclada	12	0
Aiolochroia crassa	11	3
? *Jaspis* spp.	11	3
Niphates erecta	10	3
Spheciospongia vesparium	9	3
Scolopes megastra	9	2
? *Forcepia* sp.	9	1
Neofibularia nolitangere	6	3
Iotrochota birotulata	6	2
Chondrosia spp.	6	2
CNIDARIA		
Thyroscyphus marginatus	9	2
MOLLUSCA		
Polystira albida	9	0
Chlamys benedicti	8	2
Octopus vulgaris	1	2
CRUSTACEA		
Mithrax (Mithrax) acuticornis	11	3
Dromidia antillensis	11	2
Pilumnus floridanus	11	2
Paguristes sericeus	10	2
Stenorhynchus seticornis	9	3
Macrocoeloma cf. *trispinosum*	7	3
Pagurus brevidactylus	7	2
Stenocionops furcata coelata	7	2
Micropanope laevimanus	7	2
Gonodactylus bredini	7	2
Pachycheles ackleianus	7	2
Paractaea rufopunctata nodosa	4	2
Metapenaeopsis goodei	3	3

Table 6-33. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
BRYOZOA		
Celleporaria albirostris	11	2
Stylopoma spongites	10	1
Steganoporella magnilabris	9	3
Reteporellina evelinae	2	2
ECHINODERMATA		
Ophiothrix angulata	12	2
Arbacia punctulata	11	2
Ophiothrix suensoni	3	3
ASCIDIACEA		
Didemnum candidum	11	3
Polyclinum constellatum	2	2
FISHES		
Apogon maculatus	2	3
Epinephelus morio	1	3
Serranus phoebe	1	3
Chromis enchrysurus	2	2
Synodus intermedius	1	2
Scorpaena brasiliensis	1	2
Apogon aurolineatus	1	2
Syacium papillosum	1	2
Adioryx bullisi	0	2
Scorpaena dispar	0	2
Apogon pseudomaculatus	0	2
Haemulon aurolineatum	0	2
Equetus lanceolatus	0	2
E. umbrosus	0	2
Chaetodon sedentarius	0	2
Holacanthus bermudensis	0	2
Lactophrys quadricornis	0	2

Table 6-34. Station 21: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer	57.4	27.2 Rhodophycophyta 17.7 Chlorophycophyta 9.0 Porifera (0.9 Placospongia melobesioides; several other species) 1.8 Ascidiacea (1.3 Didemnum candidum)
Fall	17.9	12.6 Porifera (1.8 P. melobesioides, 1.2 Cinachyra spp.; several other species) 1.7 Phaeophycophyta 1.7 Chlorophycophyta (0.5 Caulerpa sp.) 1.1 Cnidaria (hydroids)
Winter	23.2	13.9 Porifera (2.7 P. melobesioides, 2.2 Geodia gibberosa, 1.7 Cinachyra spp.) 5.5 Chlorophycophyta 2.3 Ascidiacea (0.9 Clavelina sp.)
Spring	19.9	11.7 Porifera (3.4 Placospongia sp.; several others) 3.2 Rhodophycophyta (0.5 Cryptonemiales) 2.7 Chlorophycophyta 1.1 Ascidiacea (1.1 Clavelina gigantea)

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

block along a NNE-SSW axis. Nearly all of the bottom was composed of a coralline algal nodule substrate overlying sand. Exposed thick sand substrate was observed with only minor coverage at this location. Occasional rock outcrops were also noted.

Taxonomic Richness & Composition -- In all, 318 benthic taxa (identified to genus or species) were identified from collections at Station 23 (Table 6-35). Predominant groups (listed in order of decreasing numbers of taxa) included Porifera, Crustacea, Gnathostomata (fishes), Echinodermata, Gastropoda, and Rhodophycophyta. Collectively, these contributed 81% of the taxa observed at this site.

Table 6-36 lists some of the most frequently captured taxa from Station 23.

Epibiotal Cover -- Total epibiotal cover was higher than at most shallower stations and varied seasonally, reaching a maximum during summer and a minimum during winter (Table 6-37). Green algae (*Anadyomene menziesii*, and to a lesser extent, *Halimeda* sp.) were abundant year-round with a slight increase during summer. Red algal cover was somewhat more seasonal, but cryptonemialid red algae (including *Peyssonnelia* spp.) were abundant year-round. Sponges consistently contributed 3% to 4% cover year-round.

Additional Remarks -- The abundance of crustose red algae in the order Cryptonemiales and the leafy green alga *Anadyomene menziesii* is a characteristic feature of mid shelf stations in the southwest portion of the study area (Stations 23, 29, and 30).

6.3.13 Station 27

Physical Features -- Station 27 was located at 24°47.76'N, 83°08.01'W; approximately 208 km from shore. Across the station block, a slight downward slope from east to west was indicated. Depths ranged from 52 to 54m. The bottom substrate was primarily thick sand (86% coverage), with lesser coverages of thin sand veneer over hard substrate (14% coverage).

Table 6-35. Station 23, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	6	5	0	6	7	2	8
PHAEOPHYCOPHYTA	3	1	0	3	5	3	6
RHODOPHYCOPHYTA	16	4	0	16	16	8	24
ANTHOPHYTA	1	0	0	1	1	0	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	52	5	0	52	53	22	74
CNIDARIA	15	1	0	15	6	3	18
ANNELIDA	0	1	1	1	0	0	1
GASTROPODA	24	1	0	24	8	3	27
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	7	0	0	7	2	2	9
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	1	0	0	1	1	1	2
ARTHROPODA-PYCNOGONIDA	0	0	0	0	1	1	1
ARTHROPODA-MANDIBULATA-CRUSTACEA	39	1	0	39	24	10	49
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	9	0	0	9	4	0	9
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	28	0	0	28	23	9	37
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	4	1	0	4	3	1	5
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	13	0	0	13	42	34	47
TOTAL	218	20	1	219	196	99	318

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-36. Species collected in at least 9 of 12 dredge samples or 3 of 4 trawl samples from Station 23.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Anadyomene menziesii	12	3
Palmellaceae n. sp.	12	3
Peyssonnelia rubra	11	4
Halimeda gracilis	7	3
PORIFERA		
? *Bubaris* spp.	7	4
? *Biemna* spp.	6	4
? *Jaspis* spp.	3	4
Hyatella intestinalis	2	3
Geodia neptuni	1	3
CNIDARIA		
Madracis asperula	7	3
CRUSTACEA		
Parthenope fraterculus	8	3
Mithrax (Mithrax) acuticornis	6	4
Macrocoeloma eutheca	3	3
Stenorhynchus seticornis	0	3
BRYOZOA		
Steganoporella magnilabris	8	4
ECHINODERMATA		
Ophiothrix angulata	12	4
Ophioderma rubicundum	8	3
Ophiomyxa flaccida	7	3
Stylocidaris affinis	5	3
Lytechinus variegatus carolinus	0	3
FISHES		
Monacanthus ciliatus	3	4
Synodus intermedius	0	4
Serranus phoebe	0	4
Scorpaena dispar	3	3
Chromis enchrysurus	1	3

Table 6-37. Station 23: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer	68.0	40.4 Rhodophycophyta (17.7 Cryptonemiales, 9.6 *Peyssonnelia rubra*, 1.5 *P. simulans*) 20.2 Chlorophycophyta (6.6 *Anadyomene menziesii*) 4.2 Porifera 3.0 Phaeophycophyta (3.0 *Dictyota* sp.)
Fall	34.7	18.4 Rhodophycophyta (8.0 *P. simulans*, 3.7 *P. rubra*, 5.7 Cryptonemiales) 11.6 Chlorophycophyta (5.8 *A. menziesii*, 2.4 *Halimeda* sp.) 4.4 Porifera
Winter	25.9	11.3 Rhodophycophyta (5.4 *P. rubra*, 5.3 *P. simulans*) 10.8 Chlorophycophyta (7.7 *A. menziesii*) 2.8 Porifera
Spring	37.1	20.3 Rhodophycophyta (9.4 *P. simulans*, 6.0 *P. rubra*, 4.8 Cryptonemiales) 12.4 Chlorophycophyta (7.3 *A. menziesii*, 3.8 *Halimeda* sp.) 3.7 Porifera

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

Taxonomic Richness & Composition -- At Station 27, 282 benthic taxa (identified to genus or species) were collected during the program (Table 6-38). Five major groups accounted for 75% of all taxa taken. Listed in order of decreasing numbers of taxa, these were Porifera, Crustacea, Gnathostomata (fishes), Gastropoda, and Echinodermata.

Table 6-39 lists some of the most frequently captured taxa from Station 27.

Epibiotal Cover -- Total epibiotal cover was low during both seasons (Table 6-40). The somewhat higher value for the Spring Cruise reflects in part the higher abundance of green algae, including *Caulerpa* sp. (although sponge cover was also estimated to be higher during spring). Any other seasonal algal blooms, especially of non-cryptonemialid red algae, are likely to have been missed because the station was not sampled during summer.

Additional Remarks -- Station 27, like Station 3, 9, and 17, was located in a relatively small patch of live bottom too small to appear on shelfwide assemblage distribution maps. Most of the substrate inshore of the station on Transect E was sand/soft bottom with a high proportion of silt/clay (see Section 5.0).

6.3.14 Station 29

Physical Features -- Station 29 was located at 24°47.51'N, 83°41.19'W; approximately 241 km from shore. Across the station, block depths varied from 60 to 65m, but no general slope was indicated. The bottom was covered with elevations and depressions, with ledges up to 1.2m relief. Substrate at this site was composed entirely of a consolidated algal nodule pavement.

Taxonomic Richness & Composition -- Benthic biological collections yielded 317 taxa (identified to genus or species) at Station 29 (Table 6-41). Predominant groups (listed in order of decreasing numbers of taxa) included Porifera, Cnidaria, Gnathostomata (fishes), Echinodermata, Gastropoda, and Crustacea. Together these groups contained 80% of all taxa identified. Station 29 supported the highest number of echinoderm species, including a large number of

Table 6-38. Station 27, all cruises combined: Number of taxa identifed to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	3	3	0	3	3	0	3
PHAEOPHYCOPHYTA	2	0	0	2	2	1	3
RHODOPHYCOPHYTA	4	1	0	4	5	4	8
ANTHOPHYTA	2	0	0	2	1	0	2
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	56	9	0	56	7	2	58
CNIDARIA	15	2	0	15	6	0	15
ANNELIDA	0	1	1	1	0	0	1
GASTROPODA	29	0	0	29	11	7	36
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	10	0	0	10	3	0	10
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	1	0	0	1	2	1	2
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	45	1	0	45	23	9	54
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	16	0	0	16	7	2	18
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	21	1	0	21	12	3	24
HEMICHORDATA	1	0	0	1	1	0	1
CHORDATA-UROCHORDATA	6	1	0	6	2	1	7
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	19	2	0	19	31	21	40
TOTAL	230	21	1	231	116	51	282

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-39. Species collected in at least 4 of 6 dredge samples or both trawl samples from Station 27.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE/SEAGRASS		
Caulerpa taxifolia	6	2
Halimeda gracilis	6	2
Thalassia testudinum	0	2
PORIFERA		
Placospongia melobesioides	6	0
Cinachyra alloclada	4	0
Spirastrella coccinea	1	2
CNIDARIA		
Oculina tenella	6	1
Thyroscyphus marginatus	5	2
Stephanoscyphus corniformis	5	2
Manicina areolata	3	2
MOLLUSCA		
Chalmys benedicti	5	0
Nemocardium tinctum	4	1
Turritella exoleta	4	0
Polystira albida	4	0
CRUSTACEA		
Paguristes sericeus	6	1
Manucomplanus corallinus	5	1
Phimochirus holthuisi	5	0
Paguristes triangulatus	5	0
Portunus spinicarpus	4	2
Scyllarus chacei	3	2
Sicyonia brevirostris	2	2
Dromidia antillensis	2	2
BRYOZOA		
Celleporaria albirostris	5	2
Cigisula cf. *turrita*	5	1
Stylopoma spongites	5	1
Steganoporella magnilabris	4	1
ECHINODERMATA		
Ophiothrix angulata	4	2
Lytechinus variegatus carolinus	1	2
ASCIDIACEA		
Didemnum candidum	6	2

Table 6-39. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
FISHES		
Halieutichthys aculeatus	5	2
Syacium papillosum	3	2
Monacanthus ciliatus	2	2
Ogcocephalus parvus	1	2
Corythoichthys albirostris	1	2
Synodus intermedius	0	2
S. poeyi	0	2
Serranus phoebe	0	2
Sphoeroides dorsalis	0	2

Table 6-40. Station 27: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer**	-	-
Fall	7.5	4.2 Porifera 1.8 Chlorophycophyta (0.9 Halimeda sp.) 0.8 Rhodophycophyta (0.8 Cryptonemiales)
Winter**	-	-
Spring	11.5	5.5 Porifera 3.7 Chlorophycophyta (2.4 Caulerpa sp., 0.8 Halimeda sp.) 0.6 Rhodophycophyta (0.6 Cryptonemiales)

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Station 27 was sampled only on the Fall and Spring Cruises.

Table 6-41. Station 29, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	7	5	0	7	4	0	7
PHAEOPHYCOPHYTA	2	1	0	2	0	0	2
RHODOPHYCOPHYTA	10	2	0	10	6	1	11
ANTHOPHYTA	0	0	0	0	1	1	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	65	11	0	65	41	9	74
CNIDARIA	37	13	0	37	27	11	48
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	20	0	0	20	10	6	26
POLYPLACOPHORA	1	0	0	1	0	0	1
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	7	0	0	7	0	0	7
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	0	0	0	0	0	0	0
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	16	1	0	16	12	8	24
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	11	0	0	11	3	1	12
BRACHIOPODA	2	0	0	2	0	0	2
ECHINODERMATA	34	0	0	34	22	5	39
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	17	3	0	17	7	2	19
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	16	1	0	16	38	28	44
TOTAL	245	37	0	245	171	72	317

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

ophiuroids and echinoids. The number of crustacean taxa collected was very low in comparison with most other stations.

Table 6-42 lists some of the most frequently captured taxa from Station 29.

Epibiotal Cover -- Total epibiotal cover was very high during all seasons, reaching a maximum in summer (Table 6-43), reflecting slight seasonal changes in the abundance of major algal groups. The leafy, deepwater green alga *Anadyomene menziesii* was the largest single contributor to total cover during all seasons, varying minimally from season to season. Crustose red algae (*Peyssonnelia* spp. and other unidentified Cryptonemiales), in contrast, were most abundant in summer and lowest during fall. Plates of the hard coral *Agaricia* sp. formed a significant portion (6% to 12%) of the cover; seasonal differences probably reflect variations in the abundance of algae that could cover or obscure the *Agaricia* in photographs. Sponges were minimally abundant at this station; *Anthosigmella varians* was a frequently noted encrusting form associated with the coral plates.

Additional Remarks -- Station 29 was a distinctive live bottom location among all stations surveyed, and was clearly the most tropical-reefal in character. Only at this station were extensive hermatypic coral structures evident, in addition to the fused coralline algal pavement (which was also noted at Station 30). Occurrence of the coral plates within and near the station reached a sharp lower depth limit at approximately 80m. In addition to the coral development, the station supported a fish assemblage that included in general a larger number of species from families typically associated with tropical reefs, including Chaetodontidae (butterflyfishes), Pomacentridae (damselfishes), Apogonidae (cardinalfishes), and Holocentridae (squirrelfishes). The tropical long-spined sea urchin, *Diadema antillarum*, the primary echinoid grazer at the Florida Middle Ground (Hopkins et al., 1977), was collected in several dredges at this station and was obtained in only one other sample (at Station 15).

Table 6-42. Species collected in at least 9 of 12 dredge samples or 3 of 4 trawl samples from Station 29.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Anadyomene menziesii	12	4
Peyssonnelia simulans	10	2
Palmellaceae n. sp.	9	1
PORIFERA		
Geodia neptuni	7	4
? *Jaspis* spp.	7	3
Xestospongia sp.	5	4
Aplysina lacunosa	4	3
Ircinia campana	1	3
CNIDARIA		
Madracis formosa	11	3
Manicina areolata	11	3
Agaricia fragilis	10	2
Madracis decactis	10	0
BRYOZOA		
Celleporaria albirostris	10	4
ECHINODERMATA		
Ophioderma rubicundum	10	2
Poraniella regularis	9	2
Ophiactis mulleri	7	4
Ophiomyxa flaccida	7	3
Arbacia punctulata	7	3
Diadema antillarum	6	3
Analcidometra armata	2	4
ASCIDIACEA		
Eudistoma capsulatum	1	3
FISHES		
Monacanthus ciliatus	4	4
Sparisoma atomarium	2	4
Serranus tortugarum	0	4
Chromis scotti	5	3
C. enchrysurus	4	3
Schultzea beta	1	3
Holocentrus rufus	0	3
Adioryx bullisi	0	3
Apogon pseudomaculatus	0	3
Chaetodon sedentarius	0	3

Table 6-43. Station 29: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover: All Epibiota	Percent Cover: Major Contributors*
Summer	89.7	42.3 Chlorophycophyta (34.2 Anadyomene menziesii)
		36.8 Rhodophycophyta (19.7 Corallinaceae, 15.9 Peyssonnelia rubra)
		7.5 Cnidaria (6.4 Agaricia sp.)
		2.3 Porifera
Fall	64.5	37.1 Chlorophycophyta (36.2 A. menziesii)
		15.8 Rhodophycophyta (8.8 P. simulans, 6.9 Cryptonemiales)
		10.3 Cnidaria (9.2 Agaricia sp.)
Winter	74.8	33.9 Chlorophycophyta (31.3 A. menziesii)
		26.9 Rhodophycophyta (10.4 P. rubra, 8.3 P. simulans, 8.2 Corallinaceae)
		11.1 Cnidaria (9.9 Agaricia sp.)
		2.2 Porifera
Spring	79.6	34.5 Chlorophycophyta (34.5 A. menziesii)
		27.4 Rhodophycophyta (13.9 P. simulans, 13.5 Cryptonemiales)
		13.8 Cnidaria (12.4 Agaricia sp.)
		3.1 Porifera

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

6.3.15 Station 30

Physical Features -- Station 30 was located at 24°47.41'N, 83°51.15'W; approximately 256 km from shore. Across the station, depth ranged from 76 to 77m. No consistent slope was indicated. Occasional 0.6m rises and depressions were observed. Bottom substrate at this site was composed entirely of a consolidated algal nodule pavement.

Taxonomic Richness & Composition -- Taxonomic richness and composition of the biota at Station 30 have been summarized in Table 6-44. A total of 201 taxa (identified to genus or species) were collected at this location. Predominant groups (listed in order of decreasing numbers of taxa) included Porifera, Cnidaria, Gnathostomata (fishes), Crustacea, and Echinodermata. Collectively, these groups accounted for 82% of all taxa observed. The number of crustacean taxa collected at this station was very low in comparison with most other stations.

Table 6-45 lists some of the most frequently captured taxa from Station 30.

Epibiotal Cover -- Total epibiotal cover was high (though not as high as at Station 29) and consistent between the two seasons sampled (Table 6-46). Crustose red algae (Order Cryptonemiales) contributed the bulk of the cover, with a lesser contribution by the leafy green alga *Anadyomene menziesii*. The other green algae present along with *A. menziesii* were *Caulerpa taxifolia* and Palmellaceae n. sp.; both were present in dredge samples from both cruises. Red algae contributing to total cover collected included *Peyssonnelia rubra*, *P. simulans*, and *Lithothamnium* spp.

Additional Remarks -- Although the substrate at this station consisted of the same fused coralline algal pavement noted at Station 29, plates of the coral *Agaricia* spp. were relatively sparsely distributed; the station was located at a depth near the lower limit of occurrence for *Agaricia* on Transect E.

Table 6-44. Station 30, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	3	1	0	3	4	1	4
PHAEOPHYCOPHYTA	1	0	0	1	0	0	1
RHODOPHYCOPHYTA	5	1	0	5	3	0	5
ANTHOPHYTA	0	0	0	0	1	1	1
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	47	4	0	47	32	13	60
CNIDARIA	26	2	0	26	10	5	31
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	3	0	0	3	1	1	4
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	5	0	0	5	0	0	5
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	0	0	0	0	1	1	1
ARTHROPODA-PYCNOGONIDA	1	0	0	1	0	0	1
ARTHROPODA-MANDIBULATA-CRUSTACEA	23	0	0	23	6	1	24
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	11	0	0	11	2	0	11
BRACHIOPODA	2	0	0	2	0	0	2
ECHINODERMATA	17	0	0	17	9	4	21
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	2	1	0	2	0	0	2
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	14	0	0	14	24	14	28
TOTAL	160	9	0	160	93	41	201

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-45. Species collected in at least 4 of 6 dredge samples or both trawl samples from Station 30.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Anadyomene menziesii	6	2
Palmellaceae n.sp.	6	1
Peyssonnelia rubra	5	1
P. simulans	4	1
Caulerpa taxifolia	2	2
PORIFERA		
Erylus formosus	5	2
? *Xestospongia* sp.	4	2
? *Bubaris* spp.	4	1
Teichaxinella shoemakeri	4	1
Halichondria sp.	3	2
? *Biemna* spp.	2	2
Geodia neptuni	2	2
Cinachyra alloclada	1	2
? *Cribrochalina* spp.	0	2
Myriastra spp.	0	2
CNIDARIA		
Stephanoscyphus corniformis	6	0
Caliacis nutans	5	1
MOLLUSCA		
Siliquaria squamata	4	0
CRUSTACEA		
Gonodactylus torus	6	0
Melybia thalamita	5	1
Micropanope sculptipes	5	0
Mithrax (Mithrax) acuticornis	4	0
ECHINODERMATA		
Ophioderma rubicundum	6	1
Ophiactis mulleri	2	2
FISHES		
Monacanthus ciliatus	2	2

Table 6-46. Station 30: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover	
	All Epibiota	Major Contributors*
Summer**	-	-
Fall	47.8	32.4 Rhodophycophyta (18.2 Cryptonemiales, 14.2 *Peyssonnelia simulans*) 9.0 Chlorophycophyta (8.6 *Anadyomene menziesii*) 4.0 Porifera 2.2 Cnidaria (primarily hydroids)
Winter**	-	-
Spring	50.4	38.3 Rhodophycophyta (22.6 Cryptonemiales, 15.7 *P. simulans*) 6.4 Chlorophycophyta (6.0 *A. menziesii*) 4.0 Porifera 1.9 Cnidaria (primarily hydroids and gorgonians)

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Station 30 was sampled only during the Fall and Spring Cruises.

6.3.16 Station 32

Physical Features -- Station 32 was located at 26°16.67'N, 84°04.08'W; approximately 183 km from shore. Across the station, depths varied from 137 to 140m. In general, the bottom sloped upward from the station center out in all directions, giving the site a slightly concave surface. Thick sand and thin sand veneer (over hard bottom) substrates predominated, each covering about 50% of the station. Occasional rock outcrops were also observed.

Taxonomic Richness & Composition -- Benthic biological collections yielded 185 taxa (identified to genus or species) at Station 32 (Table 6-47). Five major groups accounted for 79% of all taxa identified. Listed in order of decreasing numbers of taxa, these groups were Crustacea, Porifera, Gnathostomata (fishes), Echinodermata, and Cnidaria.

Table 6-48 lists some of the most frequently captured taxa from Station 32.

Epibiotal Cover -- Total epibiotal cover was very low during both seasons and was dominated by hexactinellid sponges (largely unidentifiable) and comatulid crinoids (Table 6-49); the difference in composition between seasons is probably an artifact of the low number of slides available from the Winter Cruise (17) and/or the patchy distribution of the crinoids in the area. Three species of crinoids were actually collected in dredge samples: *Neocomatella pulchella* (the most abundant), *Leptonemaster venustus*, and *Comactinia meridionalis*, all of which were generally restricted to the deep outer shelf stations. Relatively little of the biotic cover observed in photographs at this (and other deep) station(s) was identifiable to genus or species level, partly a reflection of the uncertain taxonomy of deepwater sponges.

Additional Remarks -- Although a variety of ahermatypic hard corals were generally present at the deep outer shelf stations, several of these, including *Madrepora carolina*, *Madracis asperula*, *Madracis myriaster*, and *Phyllangia americana*, were never collected from Station 32.

Table 6-47. Station 32, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0	1	1	1
PHAEOPHYCOPHYTA	1	0	0	1	1	0	1
RHODOPHYCOPHYTA	1	0	0	1	1	1	2
ANTHOPHYTA	0	0	0	0	0	0	0
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	30	1	0	30	19	5	35
CNIDARIA	14	1	0	14	5	4	18
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	13	0	0	13	1	0	13
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	4	0	0	4	0	0	4
SCAPHOPODA	1	0	0	1	0	0	1
CEPHALOPODA	0	0	0	0	1	1	1
ARTHROPODA-PYCNOGONIDA	0	0	0	0	1	1	1
ARTHROPODA-MANDIBULATA-CRUSTACEA	34	2	0	34	23	7	41
SIPUNCULA	1	0	0	1	0	0	1
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	12	1	0	12	2	1	13
BRACHIOPODA	0	0	0	0	0	0	0
ECHINODERMATA	20	0	0	20	8	0	20
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	1	1	0	1	0	0	1
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	11	0	0	11	28	21	32
TOTAL	143	6	0	143	91	42	185

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-48. Species collected in at least 4 of 6 dredge samples or both trawl samples from Station 32.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
PORIFERA		
Stylocordyla ? *longissima*	5	1
? *Bubaris* spp.	4	1
? *Adocia* spp.	1	2
Pachastrella ? *monilifera*	1	2
? *Dysidea* spp.	0	2
CNIDARIA		
Acryptolaria conferta	5	2
MOLLUSCA		
Antillophos candei	6	0
Murex tryoni	4	0
Aequipecten phrygium	4	0
CRUSTACEA		
Osachila tuberosa	5	1
Nanoplax xanthiformis	5	0
Myropsis quinquespinosa	4	1
Rhodochirus rosaceus	4	0
Parthenope fraterculus	4	0
Micropanope sculptipes	4	0
BRYOZOA		
Celleporaria tubulosa	5	0
ECHINODERMATA		
Neocomatella pulchella	6	2
Comactinia meridionalis	5	2
Stylocidaris affinis	5	1
Echinolampas depressa	5	0
Pectinaster mixtus	4	1
Rosaster alexandri	4	1
Ophioplax sp. B	4	0
FISHES		
Pontinus rathbuni	1	2
Antennarius radiosus	1	2

Table 6-49. Station 32: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover	
	All Epibiota	Major Contributors*
Summer	9.0	6.6 Porifera 1.2 Crinoidea 0.8 Cnidaria (0.8 Hydrozoa)
Fall**	-	-
Winter	8.2	5.6 Crinoidea 0.9 Crustacea (galatheid crabs) 0.6 Ascidiacea 0.4 Porifera
Spring**	-	-

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Station 32 was sampled only on the Summer and Winter Cruises.

6.3.17 Station 35

Physical Features -- Station 35 was located at 25°44.84'N, 84°21.03'W; 239 km from shore. Across the station there was a general downward slope from ESE to WNW, depths ranging from 158 to 164m. The bottom was composed primarily of a thin sand veneer substrate (over hard bottom) with lesser coverages of thick sand substrate. Occasional exposed rock outcrops were also present.

Taxonomic Richness & Composition -- In all, 156 taxa (identified to genus or species) were identified from benthic collections at Station 35 (Table 6-50). Predominant groups represented (listed in order of decreasing numbers of taxa) included Cnidaria, Echinodermata, Porifera, Crustacea, and Gnathostomata (fishes). These groups contributed 82% of all taxa taken at this location. With the exception of Station 39, which was sampled using only a rock dredge, Station 35 had the lowest number of sponge, crustacean, fish, and total taxa of any station, as well as a very low number of algal taxa.

Table 6-51 lists some of the most frequently captured taxa from Station 35.

Epibiotal Cover -- Total epibiotal cover was three times higher during summer than during winter, primarily reflecting an apparent abundance of unidentified green encrusting algae during summer (Table 6-52). However, the estimates for winter are questionable because only 18 slides were available. Although green and cryptonemialid red algae were identified in photographs, none were obtained in dredge or trawl collections. The two crinoid species most likely contributing to total crinoid cover at Station 35 were *Neocomatella pulchella* and *Crinometra brevipinna*; the latter was generally more abundant in the dredge samples.

6.3.18 Station 36

Physical Features -- Station 36 was located at 25°16.83'N, 83°57.35'W; approximately 236 km from shore. An east-west downward slope was indicated for the

Table 6-50. Station 35, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0	0	0	0
PHAEOPHYCOPHYTA	1	1	0	1	1	0	1
RHODOPHYCOPHYTA	0	0	0	0	1	1	1
ANTHOPHYTA	0	0	0	0	0	0	0
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	20	1	0	20	7	1	21
CNIDARIA	36	4	0	36	18	1	37
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	11	0	0	11	1	1	12
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	4	0	0	4	0	0	4
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	0	0	0	0	1	1	1
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	16	0	0	16	7	4	20
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	2	1	0	2	2	1	3
BRACHIOPODA	2	0	0	2	1	1	3
ECHINODERMATA	24	1	0	24	17	6	30
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	2	2	0	2	1	1	3
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	5	0	0	5	18	15	20
TOTAL	123	10	0	123	75	33	156

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-51. Species collected in at least 4 of 6 dredge samples or both trawl samples from Station 35.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
PORIFERA		
? *Bubaris* spp.	5	1
? *Penares* sp.	4	2
Discodermia sp.	1	2
CNIDARIA		
Acyptolaria conferta	5	2
Aphanipathes abietina	5	2
Siphonogorgia agassizii	5	2
Scleracis guadalupensis	5	2
Ellisella barbadensis	5	2
Nicella guadalupensis	5	2
Madrepora carolina	5	1
Stylaster sp.	4	1
Antipathes columnaris	4	1
Zygophylax convallaria	4	0
Placogorgia sp.	3	2
P. mirabilis	2	2
CRUSTACEA		
Homola barbata	1	2
BRYOZOA		
Sertella marsupiata	5	1
ECHINODERMATA		
Crinometra brevipinna	6	2
Pectinaster mixtus	6	1
Ophiothrix angulata	6	1
Asteroschema sp. B	5	2
Stylocidaris affinis	5	2
Ophioplax sp. B	5	1
Ophiomusium sp. A	5	0
Ophioplax sp. A	4	1
Echinolampas depressa	4	1
Stylometra spinifera	0	2
FISHES		
Saurida brasiliensis	0	2
Pristigenys alta	0	2

Table 6-52. Station 35: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover	
	All Epibiota	Major Contributors*
Summer	21.4	11.6 Chlorophycophyta 6.7 Porifera 1.6 Cnidaria (mostly alcyonacean corals) 0.7 Rhodophycophyta (0.4 Cryptonemiales)
Fall**	-	-
Winter	6.3	3.2 Cnidaria (2.1 Antipathidae, 1.0 <u>Ellisella barbadensis</u>) 1.7 Crinoidea 5.0 Chlorophycophyta
Spring**	-	-

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Station 35 was sampled only on the Summer and Winter Cruises.

bottom at this site, with depths ranging from 124 to 127m. Sea floor substrate was primarily thick sand, with lesser coverages of thin sand veneer over hard bottom. Occasional rock outcrops were also observed at the site.

Taxonomic Richness & Composition -- At Station 36, 205 benthic taxa were collected during the sampling program (Table 6-53). Five major groups represented 81% of the taxa identified to the genus or species level. Listed in order of decreasing numbers of taxa, these were Crustacea, Cnidaria, Echinodermata, Gnathostomata (fishes), and Porifera.

Table 6-54 lists some of the most frequently captured taxa from Station 36.

Epibiotal Cover -- Total epibiotal cover was low and the estimate for winter was somewhat higher than for summer (Table 6-55). This primarily reflects a higher abundance of crinoids in the winter photographs. Sponges and antipatharians also contributed significantly. Very few taxa of each were collected in dredge samples. The three crinoid species present, *Comactinia meridionalis*, *Neocomatella pulchella*, and *Leptonemaster venustus*, were the same as those encountered at Station 32; *L. venustus* was the most abundant in the dredge samples. The antipatharian collected during the Winter Cruise was *Antipathes pedata*.

Additional Remarks -- Station 36, the shallowest of the outer shelf stations surveyed (127m), represents the deepest occurrence of the deepwater green alga *Anadyomene menziesii* in our samples--although it was never observed in photographs at the station. Coralline algae were noted in photographs (very low cover values), and the coralline alga *Gonolithon spectabile* f. *nana* was obtained in one dredge sample.

6.3.19 Station 38

Physical Features -- Station 38 was located at 25°16.50'N, 84°14.77'W; approximately 266 km from shore. Depths varied across the station block from 156 to 161m, and a general downward slope occurred from east to west. The bottom substrate at this location was unique in relation to other live bottom sites.

Table 6-53. Station 36, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0	3	3	3
PHAEOPHYCOPHYTA	1	0	0	1	1	0	1
RHODOPHYCOPHYTA	1	0	0	1	1	1	2
ANTHOPHYTA	0	0	0	0	0	0	0
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	23	0	0	23	9	2	25
CNIDARIA	34	3	0	34	14	3	37
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	14	0	0	14	1	0	14
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	6	0	0	6	1	0	6
SCAPHOPODA	1	0	0	1	0	0	1
CEPHALOPODA	2	0	0	2	2	1	3
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	36	1	0	36	30	12	48
SIPUNCULA	1	0	0	1	0	0	1
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	1	0	0	1	0	0	1
BRACHIOPODA	1	0	0	1	0	0	1
ECHINODERMATA	25	7	0	25	17	4	29
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	5	1	0	5	2	1	7
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	8	0	0	8	25	19	27
TOTAL	159	12	0	159	106	46	205

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-54. Species collected in at least 4 of 6 dredge samples or both trawl samples from Station 36.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
ALGAE		
Anadyomene menziesii	0	2
CNIDARIA		
Placogorgia mirabilis	4	2
Placogorgia sp.	4	1
Paracyathus pulchellus	4	1
Caliacis nutans	4	0
Ellisella funiculina	3	2
Siphonogorgia agassizii	2	2
MOLLUSCA		
Semirossia equalis	1	2
Loligo pealeii	0	2
CRUSTACEA		
Micropanope sculptipes	5	0
Mesopenaeus tropicalis	4	2
Iliacantha subglobosa	4	2
Agaricochirus boletifer	4	1
Calappa angusta	4	1
Podochela lamelligera	3	2
Stenorhynchus seticornis	3	2
Munida pusilla	2	2
Portunus spinicarpus	2	2
Scyllarus depressus	1	2
Parthenope agona	1	2
Euchirograpsus americanus	0	2
ECHINODERMATA		
Comactinia meridionalis	5	2
Leptonemaster venustus	5	2
Rosaster alexandri	5	1
Asteroporpa annulata	4	2
Neocomatella pulchella	4	2
Asteroschema sp. A	3	2
Stylocidaris affinis	3	2
Ophiura sp.	1	2
Clypeaster ravenelii	1	2

Table 6-54. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
FISHES		
Rypticus bistrispinus	3	2
Halieutichthys aculeatus	1	2
Parahollardia lineata	1	2
Synodus poeyi	0	2
Ogcocephalus corniger	0	2
Prionotus stearnsi	0	2
Serranus phoebe	0	2
Citharichthys cornutus	0	2

Table 6-55. Station 36: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover	
	All Epibiota	Major Contributors*
Summer	8.6	4.0 Porifera 3.3 Crinoidea 0.8 Cnidaria (mostly alcyonacean corals)
Fall**	-	-
Winter	13.8	10.4 Crinoidea 2.0 Cnidaria (1.4 Antipathidae; 0.6 alcyonarian corals) 0.6 Porifera
Spring**	-	-

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Station 36 was sampled only during the Summer and Winter Cruises.

The sea floor was entirely composed of a coarse rubble (dead) material with attached crinoids. A few exposed rock outcrops were also noted.

Taxonomic Richness & Composition -- Benthic biological samples provided 182 taxa (identified to genus or species) from Station 38 (Table 6-56). Predominant groups (listed in order of decreasing numbers of taxa) included Cnidaria, Crustacea, Porifera, Echinodermata, and Gnathostomata (fishes). Together, these groups contributed 86% of all taxa taken. Station 38 had the lowest number of algal taxa (one) collected of any station sampled.

Table 6-57 lists some of the most frequently captured taxa from Station 38.

Epibiotal Cover -- Total epibiotal cover was generally low, but was higher during summer than winter, primarily reflecting the abundance of (unidentified) green algae during summer (Table 6-58). Crinoids, sponges, and antipatharians also contributed to epibiotal cover. The crinoids presumably included (on the basis of dredge collections) the three species noted at Stations 32 and 36 (*Neocomatella pulchella*, *Comactinia meridionalis*, and *Leptonemaster venustus*), as well as *Crinometra brevipinna* and *Stylometra spinifera*; *N. pulchella* and *L. venustus* were generally the most abundant in the dredge collections. Several species of antipatharians (*Antipathes* spp., *Aphanipathes* spp.) were present in dredge samples, though the antipatharians were not identifiable to species or genus in the photographs.

6.3.20 Station 39

Physical Features -- Station 39 was located at 24°47.16'N, 83°55.36'W; approximately 261 km from shore. Across the station, there was a downward slope from northeast to southwest. Depths ranged from 138 to 165m. The bottom was composed entirely of rock outcrops and ledges of up to 6m relief.

Taxonomic Richness & Composition -- Benthic biological samples provided only 44 taxa (identified to genus or species) from Station 39 (Table 6-59). No otter trawl samples were obtained at this site due to rough topography. Predominant groups (listed in order of decreasing numbers of taxa) included Ectoprocta,

Table 6-56. Station 38, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxomonic groups.

TAXONOMIC GROUP	# TAXA (TDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0	0	0	0
PHAEOPHYCOPHYTA	1	0	0	1	1	0	1
RHODOPHYCOPHYTA	0	0	0	0	0	0	0
ANTHOPHYTA	0	0	0	0	0	0	0
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	28	2	0	28	9	5	33
CNIDARIA	33	5	0	33	17	2	35
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	10	0	0	10	5	4	14
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	3	0	0	3	3	2	5
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	0	0	0	0	1	1	1
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	20	0	0	20	26	15	35
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	2	1	0	2	2	0	2
BRACHIOPODA	1	0	0	1	0	0	1
ECHINODERMATA	24	2	0	24	22	7	31
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	1	1	0	1	1	0	1
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	4	0	0	4	22	19	23
TOTAL	127	11	0	127	109	55	182

TDS = Triangle dredge; QSA = Quantitative slide analysis; OTH = Otter trawl, hard bottom

Table 6-57. Species collected in at least 4 of 6 dredge samples or both trawl samples from Station 38.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
PORIFERA		
? *Stoeba* sp.	5	0
Discodermia sp.	5	0
CNIDARIA		
Siphonogorgia agassizii	6	2
Madrepora carolina	6	2
Scleracis guadalupensis	6	1
Zygophylax convallaria	6	0
Scleracis petrosa	5	1
Nicella guadalupensis	5	1
Javania cailleti	5	1
Stylaster sp.	4	1
Aphanipathes humilis	4	1
Bebryce grandis	4	0
Placogorgia mirabilis	4	0
Aphanipathes abietina	3	2
Ellisella barbadensis	3	2
CRUSTACEA		
Micropanope sculptipes	5	2
Mesopenaeus tropicalis	2	2
Rhodochirus rosaceus	2	2
Nibilia antilocapra	2	2
Stenorhynchus seticornis	1	2
Processa tenuipes	0	2
ECHINODERMATA		
Comactinia meridionalis	6	2
Leptonemaster venustus	6	2
Neocomatella pulchella	6	2
Crinometra brevipinna	6	2
Ophiomusium sp. A	6	1
Stylocidaris affinis	6	1
Ophioplax sp. A	4	2
Ophiolepis sp. B	4	0
Echinolampas depressa	3	2
Ophiothrix angulata	2	2
Ophiacanthella troscheli	1	2

Table 6-57. Continued.

Group/Species	Number of Dredge or Trawl Samples Containing the Listed Species	
	Dredge	Trawl
FISHES		
Pontinus rathbuni	5	2
Antigonia capros	1	2
Serranus notospilus	0	2
Bodianus rufus	0	2
Decodon puellaris	0	2

Table 6-58. Station 38: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover	
	All Epibiota	Major Contributors*
Summer	15.5	10.2 Chlorophycophyta 2.0 Porifera 1.8 Crinoidea 1.1 Cnidaria (hard and soft corals, antipatharians)
Fall**	-	-
Winter	10.7	3.6 Crinoidea 2.7 Cnidaria (1.7 Antipathidae, 0.9 Actiniidae) 2.0 Chlorophycophyta 1.3 Porifera
Spring**	-	-

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Station 38 was sampled only during the Summer and Winter Cruises.

Table 6-59. Station 39, all cruises combined: Number of taxa identified to genus or species level captured by different live bottom sampling methods. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (RDS)	# TAXA (QSA)	# ADDITIONAL TAXA	CUMULATIVE # TAXA	# TAXA (OTH)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0	0	0	0
CHLOROPHYCOPHYTA	0	1	1	1	0	0	1
PHAEOPHYCOPHYTA	0	0	0	0	0	0	0
RHODOPHYCOPHYTA	0	1	1	1	0	0	1
ANTHOPHYTA	0	0	0	0	0	0	0
PROTOZOA	0	0	0	0	0	0	0
PORIFERA	5	2	0	5	0	0	5
CNIDARIA	5	1	0	5	0	0	5
ANNELIDA	0	0	0	0	0	0	0
GASTROPODA	1	0	0	1	0	0	1
POLYPLACOPHORA	0	0	0	0	0	0	0
APLACOPHORA	0	0	0	0	0	0	0
BIVALVIA	2	0	0	2	0	0	2
SCAPHOPODA	0	0	0	0	0	0	0
CEPHALOPODA	0	0	0	0	0	0	0
ARTHROPODA-PYCNOGONIDA	0	0	0	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	4	0	0	4	0	0	4
SIPUNCULA	0	0	0	0	0	0	0
PRIAPULIDA	0	0	0	0	0	0	0
PHORONIDA	0	0	0	0	0	0	0
ECTOPROCTA	22	0	0	22	0	0	22
BRACHIOPODA	1	0	0	1	0	0	1
ECHINODERMATA	0	0	0	0	0	0	0
HEMICHORDATA	0	0	0	0	0	0	0
CHORDATA-UROCHORDATA	0	1	1	1	0	0	1
CHORDATA-CEPHALOCHORDATA	0	0	0	0	0	0	0
CHORDATA-GNATHOSTOMATA	1	0	0	1	0	0	1
TOTAL	41	6	3	44	0	0	44

ABBREVIATIONS: TDS = TRIANGLE DREDGE; QSA = QUANTITATIVE SLIDE ANALYSIS; OTH = OTTER TRAWL. RDS=ROCK DREDGE SAMPLE

Porifera, Cnidaria, and Crustacea. Collectively, these groups contributed 82% of all taxa identified.

Table 6-60 lists some of the most frequently captured taxa from Station 39.

Epibiotal Cover -- Total epibiotal cover was about three times higher during summer than winter, reflecting the high abundance of (unidentified) green algae during summer (Table 6-61). Sponges and ascidians also contributed significantly to total cover.

Additional Remarks -- Station 39 was located on a relatively steep portion of Transect E at the shelf break; because of the rugged topography of the station, sampling was limited to use of a rock dredge, and the photographic surveys were also problematic. The station was therefore not characterized as adequately as were other deep stations. The large number of bryozoan species collected [much higher than at other deep stations and exceeded only by the number of species obtained at some mid shelf stations (e.g., Stations 3, 9, and 17)] presumably reflects the large amount of emergent substrate for attachment. Low levels of coralline algal cover (<1%) were noted in photographs even at this deep station.

6.4 SHELFWIDE DISTRIBUTION AND ZONATION PATTERNS

It is evident from individual station descriptions in the previous section that live bottom communities of the southwest Florida shelf can be grouped on the basis of shared similarities and dissimilarities. This is not a surprising conclusion considering the range of depth, latitude, and substrate type encompassed; moreover, stations were selected from within representative community types delineated during the initial television transect surveys, so that one would expect to identify groups of similar stations. However, there are no universal criteria to define similarity, and classification based on the television surveys is necessarily somewhat subjective. The television surveys can be likened to flying over a forest and defining zones based on easily recognizable visual differences; these well-defined zonation patterns may often be more apparent than real. In this section, shelfwide distribution patterns are eval-

Table 6-60. Species collected in at least 2 of 6 rock dredge samples from Station 39.

Group/Species	Number of Dredge Samples Containing the Listed Species
PORIFERA	
? *Bubaris* spp.	2
Epipolasis spp.	2
? *Teichaxinella* sp.	2
CNIDARIA	
Eudendrium carneum	2
Paracyathus pulchellus	3
BRYOZOA	
Aplousina filum	2
Colletosia radiata	3
Hippaliosina rostrigera	3

Table 6-61. Station 39: Percent cover estimates, derived from quantitative slide analysis, for all epibiota and major contributors. Seasonal designations refer to the period when each cruise was conducted.

Season	Percent Cover	
	All Epibiota	Major Contributors*
Summer	54.1	44.3 Chlorophycophyta 9.6 Porifera
Fall**	-	-
Winter	17.1	9.3 Chlorophycophyta 5.4 Porifera 1.3 Ascidiacea 0.4 Rhodophycophyta (0.4 Corallinaceae, including *Lithothamnium* sp.)
Spring**	-	-

*The level of taxonomic identification varied for different groups. Percent cover estimates for all taxa within a major group were pooled; the contributions of particularly abundant species, genera, or other taxonomic groupings are shown in parentheses.

**Station 39 was sampled only during the Summer and Winter Cruises.

uated by several approaches. First, the assemblages delineated by the television transect surveys are reviewed and the stations classified on that basis. Second, results of the previous section's station descriptions, based primarily on quantitative slide analysis, are combined to produce a zonation scheme. Third, results of cluster analyses of dredge and trawl collections are presented and discussed. Finally, the results of these different approaches to defining distribution patterns are evaluated, integrated, and compared with previously published zonation schemes.

6.4.1 Zonation Based on Television Transect Surveys

Live bottom biological assemblages were defined in Section 2.0 on the basis of television transect surveys. It should be noted, however, that many generic and species level identifications from television footage were made possible only by knowledge obtained from dredge and trawl collections. The assemblages that were identified and the expected affinities of live bottom stations are reviewed below. Figure 6-2 shows the location of all sampling stations in relation to the distribution of substrates and biological assemblages on the shelf.

Inner Shelf Live Bottom Assemblage I -- This assemblage consisted of patches of various algae (*Caulerpa* spp., *Halimeda* spp., and *Udotea* spp.), ascidians, hard corals (*Siderastrea* spp.), large gorgonians (*Eunicea* spp., *Muricea* spp., *Pseudoplexaura* spp., and *Pseudopterogorgia* spp.), hydrozoans, and sponges (*Geodia gibberosa*, *Haliclona* spp., *Ircinia campana*, and *Spheciospongia vesparium*). Individual organisms were generally larger, and the fauna appeared to exhibit a higher biomass per unit area, than in the Inner and Middle Shelf Live Bottom Assemblage II. This assemblage was identified from water depths of 20 to 27m on Transects C and D.

Stations 13 and 19 were located in areas characterized by this assemblage (Figure 6-2).

Inner and Middle Shelf Live Bottom Assemblage II -- This assemblage consisted of algae (*Cystodictyon pavonium*, *Halimeda* spp., and *Udotea* spp.), ascidians

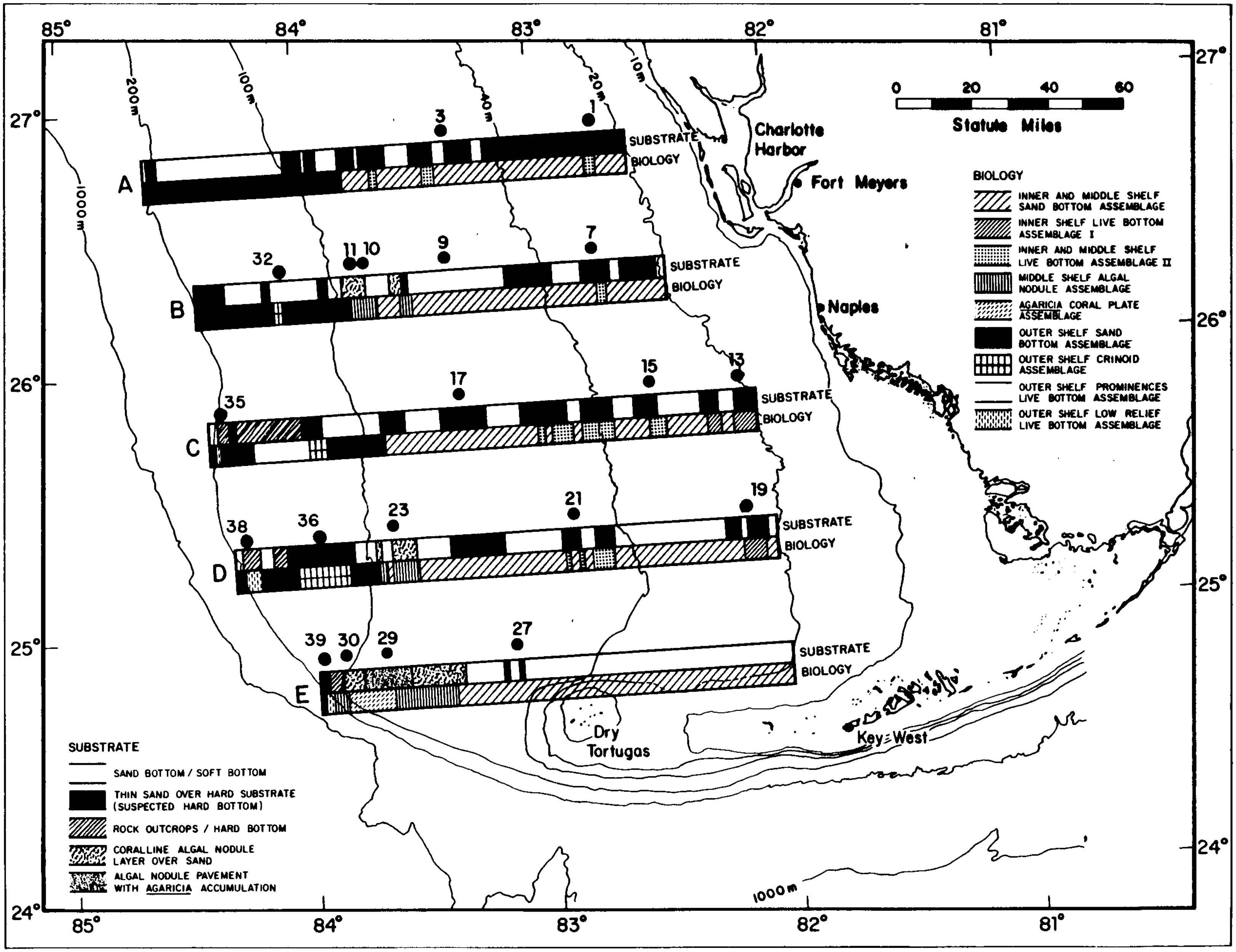


Figure 6-2. Live bottom sampling stations relative to generalized substrate and biological assemblage distributions.

(Clavelina gigantea), bryozoans (Celleporaria spp. and Stylopoma spongites), hard corals (Cladocora arbuscula, Scolymia lacera, Siderastrea spp., and Solenastrea hyades), small gorgonians, hydrozoans, and several sponges (Cinachyra alloclada, Geodia gibberosa, G. neptuni, Ircinia spp., Placospongia melobesioides, and Spheciospongia vesparium). It appeared to have both a higher number of sponge species and a lower biomass per unit area than the Inner Shelf Live Bottom Assemblage I. Live Bottom Assemblage II occurred in water depths of 25 to 71m on Transects A, B, C, and D.

Stations 1, 3, 7, 9, 15, 17, 21, and 27 were located in areas characterized by this biological assemblage. The presence of the assemblage at Stations 3, 9, 17, and 27 is not evident in Figure 6-2 because the areal extent of the epibiotal community at each station was small.

Middle Shelf Algal Nodule Assemblage -- This assemblage consisted of coralline algal nodules formed by two genera of algae, Lithophyllum spp. and Lithothamnium spp., combined with sand, silt, and clay particles. Algae (Halimeda spp., Peyssonnelia spp., and Udotea spp.), hard corals, and small sponges (Cinachyra alloclada and Ircinia spp.) were also present. The assemblage was identified from water depths of 62 to 108m, primarily along Transects B, D, E, and F.

Stations 10, 11, 23, and 30 were located in areas characterized by this assemblage (Figure 6-2).

Agaricia Coral Plate Assemblage -- This assemblage consisted of a dead, hard coral-coralline algae substrate covered with living algae (Anadyomene menziesii and Peyssonnelia spp.), live hard corals (Agaricia spp. and Madracis spp.), gorgonians, and sponges. It was identified from water depths of 64 to 80m (Figure 6-2, Transect E).

Only Station 29 was located in an area characterized by this assemblage.

Outer Shelf Crinoid Assemblage -- This biological assemblage consisted of large numbers of crinoids of the species Comactinia meridionalis, Neocomatella pulchella, and Leptonemaster venustus, living on a coarse sand or rock rubble substrate. Small hexactinellid sponges may also be associated with this assemblage. The assemblage was identified from water depths of 118 to 168m on Transects B, C, and (especially) D.

Stations 32 and 36 were located in areas characterized by this assemblage (Figure 6-2).

Outer Shelf Low-Relief Live Bottom Assemblage -- This assemblage consisted of various octocorals (including Nicella guadalupensis), the antipatharian corals Antipathes spp., Aphanipathes abietina, A. filix, and A. humilis, occasional hard corals (including Madrepora carolina), crinoids, the hydrozoan Stylaster sp., and small sponges in the order Dictyonina. It was found in conjunction with low-relief rock surfaces with a thin sand veneer. Characteristically, this type of assemblage was identified in water depths of 125 to 185m on Transects C and D and from 108 to 198m water depths on Transect E (Figure 6-2).

Stations 35, 38, and 39 were located in areas characterized by this assemblage. Station 39, however, exhibited higher relief (up to 6m) than the other two stations.

Outer Shelf Prominences Live Bottom Assemblage -- This assemblage consisted of the gorgonian Nicella guadalupensis; the antipatharian corals Antipathes spp., Aphanipathes abietina, A. filix, and A. humilis; the hard coral Madrepora carolina; crinoids; the hydrozoan Stylaster sp.; and medium to large hexactinellid sponges in the order Dictyonina. All of these organisms were attached to "rock" prominences. The prominences generally emerged from a sand-covered bottom and had a vertical relief of up to 2m. These prominences are most likely dead coral pinnacles--remnants of old, buried reefs formed by calcareous algae (Ludwick and Walton, 1957). The Outer Shelf Prominences assemblages extended from water depths of 136 to 169m on Transect C (Figure 6-2).

No stations were located in areas typified by this assemblage, due to the difficulty of sampling.

Summary -- Seven live bottom assemblages have been defined, six of which were represented by at least one station sampled during the two years of study. The expected station groupings based on these assemblage definitions are indicated on Figure 6-3 (the lines surrounding station groupings are not intended to imply areal extent of the assemblages).

6.4.2 Zonation Based on QSA

Characterizations of individual stations in Section 6.3 were based partly on examination of results from quantitative slide analysis (QSA) of still camera photographs, which provides a more quantitative basis for classification of biological assemblages observed than does television transect data. Ideally, one could use classification or ordination techniques (Boesch, 1977) to assist in the delineation of biologically similar stations. However, the use of QSA data in such analyses has serious problems: the level of identification from photographs varies depending on the group (e.g., many common sponges cannot be conclusively identified without making a spicule mount), and the amount of information deleted by truncating the data set to include only those taxa identifiable to genus or species varies from a few to nearly 100% at different stations (see Section 6.6.3). We did conduct cluster analyses on truncated QSA data but found the results to be poor; even when well-defined, reasonable groupings were produced, the results appeared (upon examination of two-way frequency-of-occurrence tables) to be fortuitous. Therefore, the following discussion is based primarily on examination of QSA data for each station from the tables presented in Section 6.3 and summary tables presented in this section. This approach is subject to the same problems encountered in a formal cluster analysis in that multispecific and multigeneric taxa are included. However, the results can be interpreted cautiously to produce a general view of trends in biological characteristics of stations.

Tables indicating the major contributors to epibiotal cover have been provided for each station in Section 6.3. These observations are summarized in Tables 6-62 through 6-65, which list the abundance of major contributors to total cover for each station on each of the four biological cruises. Figure 6-4 illustrates the shelfwide variation in average epibiotal cover. Cover was gener-

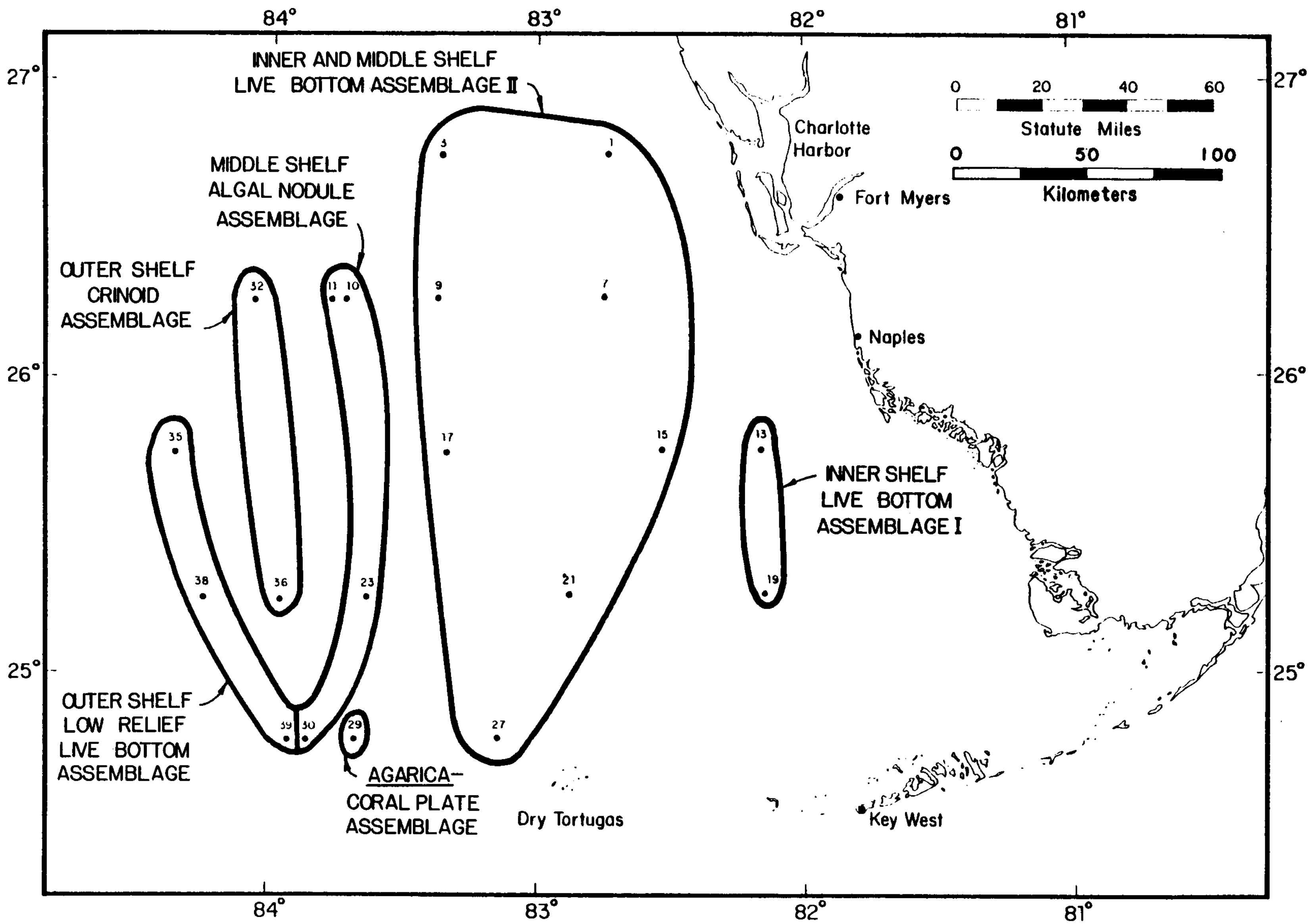


Figure 6-3. Groupings of live bottom stations on the basis of television transect surveys.

Table 6-62. Fall Cruise (October 25-November 25, 1980): Average percent cover of taxa in Quantitative Slide Analysis for dominant taxa (mean total percent cover ≥0.5% in any one of the four cruises).

TAXON	STATION 01	03	07	09	10	11	13	15	17	19	21	23	27	29	30
CHLOROPHYCOPHYTA	6.8	.1	.6	1.7	1.4	2.7	.6	.0	1.1	.0	1.1	3.3	.7	.9	.3
CAULERPA SP.	.0	.5	.0	.1	.1	.0	2.3	.0	3.1	3.0	.5	.0	.3	.0	.0
HALIMEDA SP.	.0	1.4	.2	9.4	1.3	.0	.3	2.2	4.6	.0	.1	2.4	.9	.0	.0
ANADYOMENE MENZIESII	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	5.8	.0	36.2	8.6
PHAEOPHYCOPHYTA	6.1	.0	.0	1.8	.1	.3	5.9	.0	.0	.7	1.7	.0	.0	.0	.1
RHODOPHYCOPHYTA	.0	.0	.0	.3	1.2	3.2	.4	.2	1.5	.1	.0	1.0	.0	.0	.0
CRYPTONEMIALES	.0	.1	.0	.8	2.1	2.0	.0	.7	.0	.0	.1	5.7	.8	6.9	18.2
PEYSSONNELIA RUBRA	.0	.0	.0	.0	.9	1.0	.0	.0	.0	.0	.0	3.7	.0	.0	.0
PEYSSONNELIA SIMULANS	.0	.0	.0	.0	1.6	1.8	.0	.0	.0	.0	.0	8.0	.0	8.8	14.2
PORIFERA	.4	1.1	1.9	.0	.4	.2	.4	3.0	.8	4.7	3.1	.1	1.5	.2	.7
CALCAREA	.1	1.1	2.3	.1	1.2	1.2	.0	.1	1.0	.4	3.3	4.3	.9	.5	3.2
PLACOSPONGIA MELOBESIOIDES	.0	1.3	2.3	.0	.0	.0	.1	2.6	.0	.1	1.8	.0	.5	.0	.0
GEODIA SP.	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.2	.0	.1
CINACHYRA SPP.	.2	.6	1.1	.0	.1	.1	.2	1.2	.0	.1	1.2	.0	.1	.0	.0
HYDROZOA	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0
OCTOCORALLIA-GORGONACEA	.3	.0	.0	.0	.1	.0	5.8	.0	.0	.7	.0	.0	.1	.0	.0
AGARICIA SP.	.0	.0	.0	.0	.0	.0	.0	.4	.0	.0	.0	.0	.0	9.2	.0
CRINOIDEA	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	.0

NOTE: OCTOCORALLIA-GORGONACEA DOES NOT MEET DOMINANCE CRITERIA OF 0.5 %.
SEE TEXT FOR EXPLANATION.

Table 6-63. Spring Cruise (April 22-May 5, 1981): Average percent cover of taxa in Quantitative Slide Analysis for dominant taxa (mean total percent cover $\geq 0.5\%$ in any one of the four cruises).

TAXON	STATION 01	03	07	09	10	11	13	15	17	19	21	23	27	29	30
CHLOROPHYCOPHYTA	.7	.7	.0	.3	.1	.0	.2	.0	.4	.0	2.6	1.2	.5	.0	.4
CAULERPA SP.	.0	.0	.0	.0	.1	.0	.0	.0	.7	.0	.0	.1	2.4	.0	.0
HALIMEDA SP.	.0	.0	.0	3.9	.7	.2	.0	.0	.6	.0	.0	3.8	.8	.0	.0
ANADYOMENE MENZIESII	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	7.3	.0	34.3	6.0
PHAEOPHYCOPHYTA	15.2	3.5	2.6	5.7	7.2	.0	.8	.4	1.7	.3	.6	.1	.1	.0	.0
RHODOPHYCOPHYTA	.0	1.0	.0	.2	.2	.0	.0	2.3	.0	.0	2.6	.1	.0	.0	.0
CRYPTONEMIALES	.4	.5	.0	.9	1.3	.0	.0	.0	.2	.0	.5	4.8	.5	13.5	22.6
PEYSSONNELIA RUBRA	.0	.0	.0	.0	2.2	.9	.0	.0	.0	.0	.0	6.0	.0	.0	.0
PEYSSONNELIA SIMULANS	.0	.0	.0	.0	2.3	3.3	.0	.0	.0	.0	.0	9.4	.0	13.9	15.7
PORIFERA	.5	1.2	1.4	.3	2.4	.8	6.0	4.1	1.5	.9	5.0	3.6	3.7	2.6	3.9
CALCAREA	.6	3.1	2.2	1.5	3.5	.5	.6	2.1	1.4	.0	.5	.0	.0	.2	.0
PLACOSPONGIA MELOBESIOIDES	.0	2.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
GEODIA SP.	.0	.0	.1	.0	.3	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0
CINACHYRA SPP.	1.3	.6	1.2	.0	.7	.0	.3	1.2	.0	.3	.7	.0	.4	.0	.0
HYDROZOA	.0	.0	.0	.0	.0	.7	8.1	.0	.0	.1	.0	.0	.0	.0	.0
OCTOCORALLIA-GORGONACEA	.0	.3	.0	.0	.1	.1	1.7	.0	.0	1.3	.0	.0	.0	.0	1.1
AGARICIA SP.	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0	12.4	.1
CRINOIDEA	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	.0

NOTE: OCTOCORALLIA-GORGONACEA DOES NOT MEET DOMINANCE CRITERIA OF 0.5%. SEE TEXT FOR EXPLANATION.

Table 6-64. Summer Cruise (July 16-August 5, 1981): Average percent cover of taxa in Quantitative Slide Analysis for dominant taxa (mean total percent cover 0.5% in any one of the four cruises).

TAXON	STATION 01	03	07	09	11	13	15	21	23	29	32	35	36	38	39
CYANOPHYTA	.0	1.4	2.7	.1	.0	45.8	1.1	.2	.0	.0	.0	.0	.0	.0	.0
CHLOROPHYCOPHYTA	8.6	2.2	2.1	3.9	14.2	6.1	17.8	15.6	12.4	8.0	.2	11.6	.0	10.1	44.3
CAULERPA SP.	.0	.6	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
HALIMEDA SP.	.1	.3	.1	4.3	.2	.0	.0	.1	.5	.0	.0	.0	.0	.0	.0
ANADYOMENE MENZIESII	.0	.0	.0	.0	.0	.0	.0	.0	6.6	34.2	.0	.0	.0	.0	.0
PHAEOPHYCOPHYTA	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
SARGASSUM SP.	.0	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0	.1	.0	.0	.0
RHODOPHYCOPHYTA	11.4	1.6	1.2	1.7	2.4	1.4	5.7	26.4	11.6	.0	.0	.3	.0	.0	.0
GRACILARIA SP.	1.4	.9	1.2	.3	.6	1.1	7.8	.4	.0	.0	.0	.0	.0	.0	.0
CRYPTONEMIALES	.9	.0	.0	.0	1.2	.0	.0	.0	17.7	.0	.0	.4	.0	.0	.0
PEYSSONNELIA RUBRA	.0	.3	.0	.0	3.4	.0	.0	.0	9.6	15.9	.0	.0	.0	.0	.0
PEYSSONNELIA SIMULANS	.0	.0	.0	.0	1.4	.0	.0	.0	1.5	1.2	.0	.0	.0	.0	.0
CORALLINACEAE	.0	.8	.2	.0	.0	.0	.0	.0	.0	19.7	.0	.0	.1	.1	.0
PORIFERA	.2	1.8	2.4	1.1	6.3	.6	4.9	5.7	4.2	1.5	6.6	6.6	3.9	1.9	9.6
PLACOSPONGIA MELOBESIOIDES	.0	.5	.7	.0	.0	.0	1.5	.9	.0	.0	.0	.0	.0	.0	.0
GEODIA NEPTUNI	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0
CINACHYRA SPP.	.1	.0	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
HYDROZOA	.0	.1	.0	.0	.2	.0	.0	.0	.0	.0	.7	.0	.1	.0	.0
GORGONIIDAE	.0	.0	.0	.0	.0	2.3	.0	.0	.0	.0	.0	.0	.4	.0	.0
AGARICIA SP.	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.4	.0	.0	.0	.0	.0
CRINOIDEA	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	1.2	.4	3.3	1.8	.0

Table 6-65. Winter Cruise (January 28-February 15, 1982): Average percent cover of taxa in Quantitative Slide Analysis for dominant taxa (mean total percent cover $\geq 0.5\%$ in any one of the four cruises.)

TAXON	STATION 01	03	07	09	11	13	15	21	23	29	32	35	36	38	39
CHLOROPHYCOPHYTA	.3	.3	.1	1.1	.4	.0	.3	5.5	2.1	2.3	.0	.5	.0	2.0	9.3
CAULERPA SP.	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
HALIMEDA SP.	.3	.0	.0	5.3	.1	.0	.3	.0	.8	.0	.0	.0	.0	.0	.0
ANADYOMENE MENZIESII	.0	.0	.0	.0	.0	.0	.0	.0	7.7	31.1	.0	.0	.0	.0	.0
PHAEOPHYCOPHYTA	1.1	.3	.0	.5	.0	1.2	.0	.0	.0	.0	.0	.0	.1	.1	.1
SARGASSUM SP.	6.6	.0	.3	.0	.0	.8	.0	.0	.0	.0	.0	.0	.0	.0	.0
RHODOPHYCOPHYTA	.1	.0	.0	.1	.1	.0	.0	.1	.2	.0	.0	.0	.0	.0	.1
GRACILARIA SP.	.0	.6	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
PEYSSONNELIA RUBRA	.0	.0	.0	.0	1.0	.0	.0	.0	5.4	10.4	.0	.0	.0	.0	.0
PEYSSONNELIA SIMULANS	.0	.0	.0	.0	.3	.0	.0	.0	5.3	8.3	.0	.0	.0	.0	.0
CORALLINACEAE	.3	.1	.0	.0	.8	.0	.2	.4	.0	8.2	.0	.0	.4	.0	.3
PORIFERA	.3	1.5	1.5	.3	12.3	1.6	3.2	3.3	2.5	1.8	.2	.2	.5	1.2	5.2
CALCAREA	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
PLACOSPONGIA MELOBESIOIDES	.0	4.2	4.4	.0	.0	.0	3.5	2.7	.0	.0	.0	.0	.0	.0	.0
GEODIA SP.	.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
GEODIA NEPTUNI	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
CINACHYRA SPP.	.8	.7	2.4	.1	.0	.2	2.3	1.7	.0	.0	.2	.0	.0	.0	.0
HYDROZOA	.0	.0	.0	.0	.1	.0	.5	.3	.0	.0	.4	.0	.0	.2	.0
GORGONIIDAE	.0	.0	.0	.0	.0	11.4	.0	.0	.0	.0	.0	.0	.0	.0	.0
AGARICIA SP.	.0	.0	.0	.0	.0	.0	.0	.0	.0	9.9	.0	.0	.0	.0	.0
CRINOIDEA	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	5.6	1.7	10.4	3.6	.1

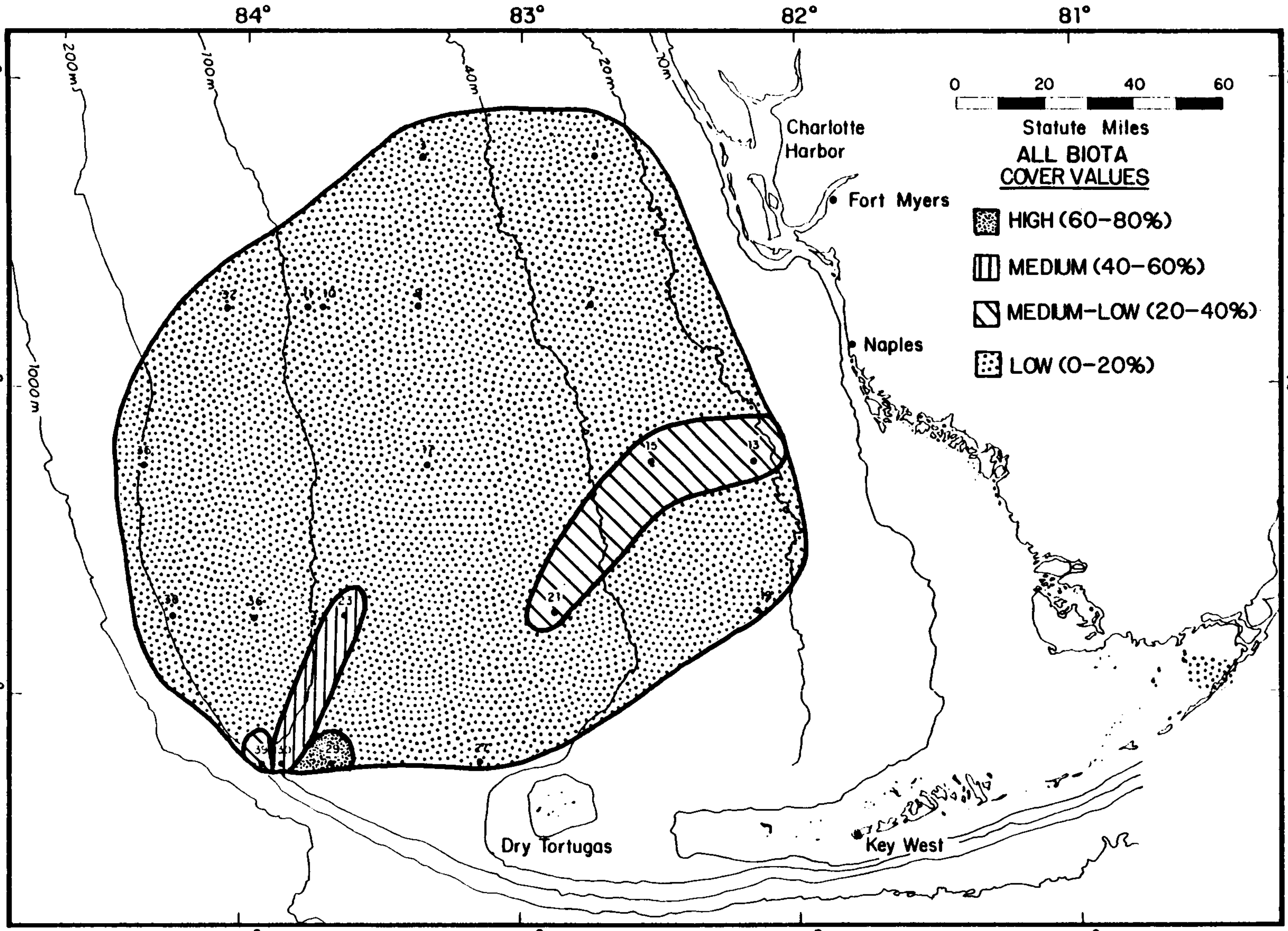


Figure 6-4. Shelfwide variation in average (all cruises) percent biotal cover at live bottom stations.

ally highest in the southern and southwest portions of the study area (especially Stations 29, 30, 23, and 39) and lowest at the deep Stations 32, 35, 36, and 38. Algae and sponges were, in general, the major contributors to total cover, with the exception of high gorgonian cover at Station 13, hard coral cover (*Agaricia* spp.) at Station 29, and crinoid cover at Stations 32, 36, and 38. The shelfwide variation in average sponge cover is shown in Figure 6-5; the highest values were noted at Stations 15, 19, and 21, and the lowest values occurred at Stations 1, 9, and 29. Algal cover was too seasonal at most stations to be meaningfully represented by average cover values (see Section 6.5.3).

Certain station similarities are immediately evident and have been mentioned in the discussions in Section 6.3. Stations 23 and 30 were similar in the abundance of perennial red (*Peyssonnelia* spp.) and green (*Anadyomene menziesii*) algae, with a lesser contribution by sponges. Station 29, though similar to Station 30 in substrate (algal nodule pavement) and to both Stations 23 and 30 in being dominated by the same perennial red and green algae, was unique in having a significant contribution by *Agaricia* sp. corals (which were present, but not abundant, at Station 30) and a much higher year-round abundance of *Anadyomene menziesii*. Stations 11 and (to a lesser extent) 10 also appear somewhat similar to Stations 23 and 30 in that a cryptonemialid algal component was significant; however, *A. menziesii* was absent from the former stations and percent biotal cover was generally lower there.

The deeper stations (32, 35, 36, and 38) had in common a sparse suspension-feeding assemblage consisting primarily of crinoids, small hexactinellid sponges, antipatharians, small ahermatypic hard corals, and ascidians rather than the dense and diverse assemblages of larger sponges found at mid shelf depths. Soft corals and antipatharians were also observed in photographs at these stations. Among the soft coral, *Ellisella barbadensis* was noted at all the deep stations except Station 39, whereas *Scleracis guadalupensis* was noted only at Stations 35 and 38. Stations 32 and 36 had, on the average, higher levels of crinoid cover than did Stations 35 and 38. Stations 35 and 38, which were located at greater depths (159 m vs. 127 to 137 m), also exhibited significant seasonal cover by (unidentified) encrusting green algae. Stations 32

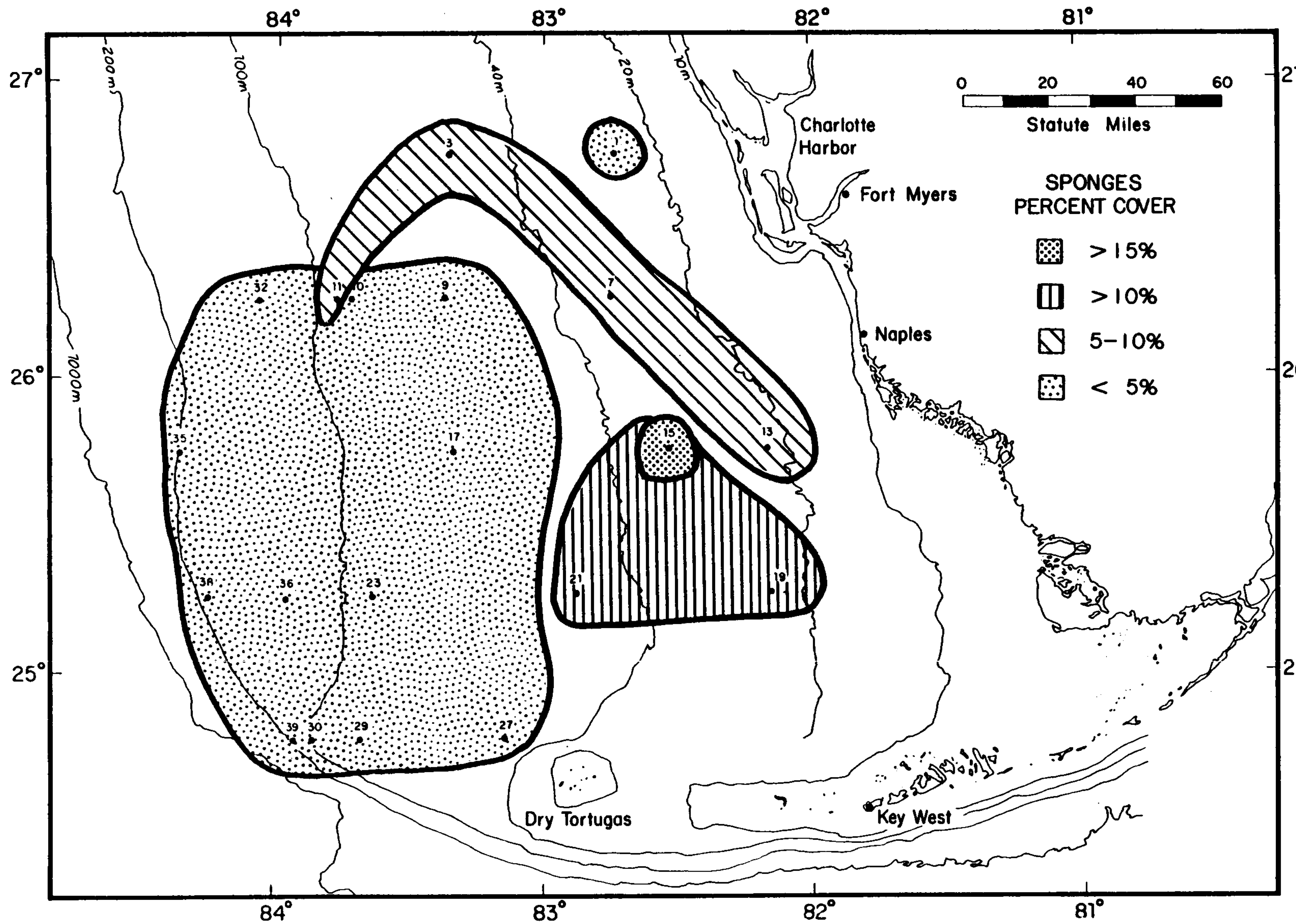


Figure 6-5. Shelfwide variation in average (all cruises) sponge cover at live bottom stations.

and 36 lacked a seasonal algal component. Cryptonemialid red algae (including coralline algae) contributed minor amounts of cover at Stations 35, 38, and 39 but not at Stations 32 and 36.

Station 39, not surprisingly, appeared somewhat distinct in epibiotal composition from other stations, presumably a reflection of the relatively high relief present. Crinoids were much less abundant here than at the other deep stations, where they were generally associated with coarse rubble rather than outcrops/hard bottom characteristic of Station 39. The seasonal (summer) abundance of (unidentified) green algae is similar to that observed at other shelf-edge stations (35, 38). Coralline algae (including *Lithothamnium* sp.) contributed a small amount of cover during winter.

Among the remaining inner and middle shelf stations, only Station 13 appears highly distinctive: gorgonians were highly abundant, a blue-green algal bloom occurred during summer, and hydroids were very abundant at least on one cruise (spring). [Gorgonians were identified only to Order Gorgonacea during Year One (Tables 6-62 and 6-63) but the families Gorgoniidae and Plexauridae were distinguished during Year Two (Tables 6-64 and 6-65).] The other stations comprise a group that is difficult to subdivide into readily identifiable clusters. Most of these stations exhibited a mixed assemblage of sponges and algae, with the relative contribution of these two major groups and the seasonal variation in the composition of epibiotal cover ranging widely. Predictable seasonal blooms of algae were apparent, especially at inner shelf stations--e.g., brown algae (*Sargassum* sp. and others) in spring, red algae (*Gracilaria* sp. and others) in summer, and green algae (e.g., *Caulerpa* sp.) in Summer and/or Fall. At some deeper stations, *Halimeda* and crustose perennials (Cryptonemiales) were present, but their abundance was generally low and variable. Sponge cover was generally high at mid shelf depths (Stations 15, 21, and to a lesser extent, 3 and 7) and was also high at the shallow Station 19. Based on these characteristics, several groups of stations can be identified. Station 1 was unique in that seasonal algal blooms dominated cover during all seasons; sponge cover was relatively low. At Stations 3, 7, 15, 19, 21, and 27, sponge cover generally dominated except during summer, when seasonal algal blooms contributed significant cover. Within this group of stations, Stations 15, 19, and 21 had very high levels of sponge cover, but many species contributed to the total at Stations 15 and 21 whereas Geodia spp. (especially Geodia gibberosa) were dominant at Station 19. Stations 3 and 7 both had moderate levels of sponge cover and it was neither as diverse as at Stations 15 and 21 nor as dominated by a few species as at Station 19. Finally, Stations 9 and 17 appeared distinct in several respects: sponge cover (and total cover) was low, the green alga Halimeda sp. dominated (most seasons at Station 9; fall only at Station 17), and bryozoans contributed significant proportions of total cover. Several other mid shelf stations (3, 7, 15, 21, 27) exhibited occasional abundances of Halimeda sp. or cryptonemialid red algae that suggest the beginnings of a transition to the coralline algal nodule assemblage. Figure 6-6 illustrates the general groupings of stations evident from the preceding discussion, and Table 6-66 summarizes the distinguishing characteristics of these station groupings.

6.4.3 Zonation Based on Cluster Analyses

Shelfwide distribution patterns for live bottom biota can be evaluated on the basis of cluster analysis of results from triangle dredge and otter trawl collections. QSA data are not amenable to cluster analysis because many taxa that contribute a significant portion of total cover cannot be identified to the genus or species level from photographs, negating the advantages afforded by quantitative data.

Methods for normal and inverse cluster analyses have been described in Section 3.2. IN ORDER TO REDUCE THE DATA MATRIX TO A MANAGEABLE SIZE, ALL DATA SETS WERE TRUNCATED by 1) including only organisms identified to the genus or species level, and 2) excluding rarely collected taxa. The latter was accomplished by specifying that a genus or species would be included in the analysis only if it occurred in at least a certain number of samples or at a certain minimum number of stations. The inclusion criteria are summarized in Table 6-67. Generally, about 100 to 150 taxa were thereby included in each analysis, representing 10% to 20% of the total taxa for a given data set and about 40% of the total occurrences. The deletion of relatively uncommon or non-widely

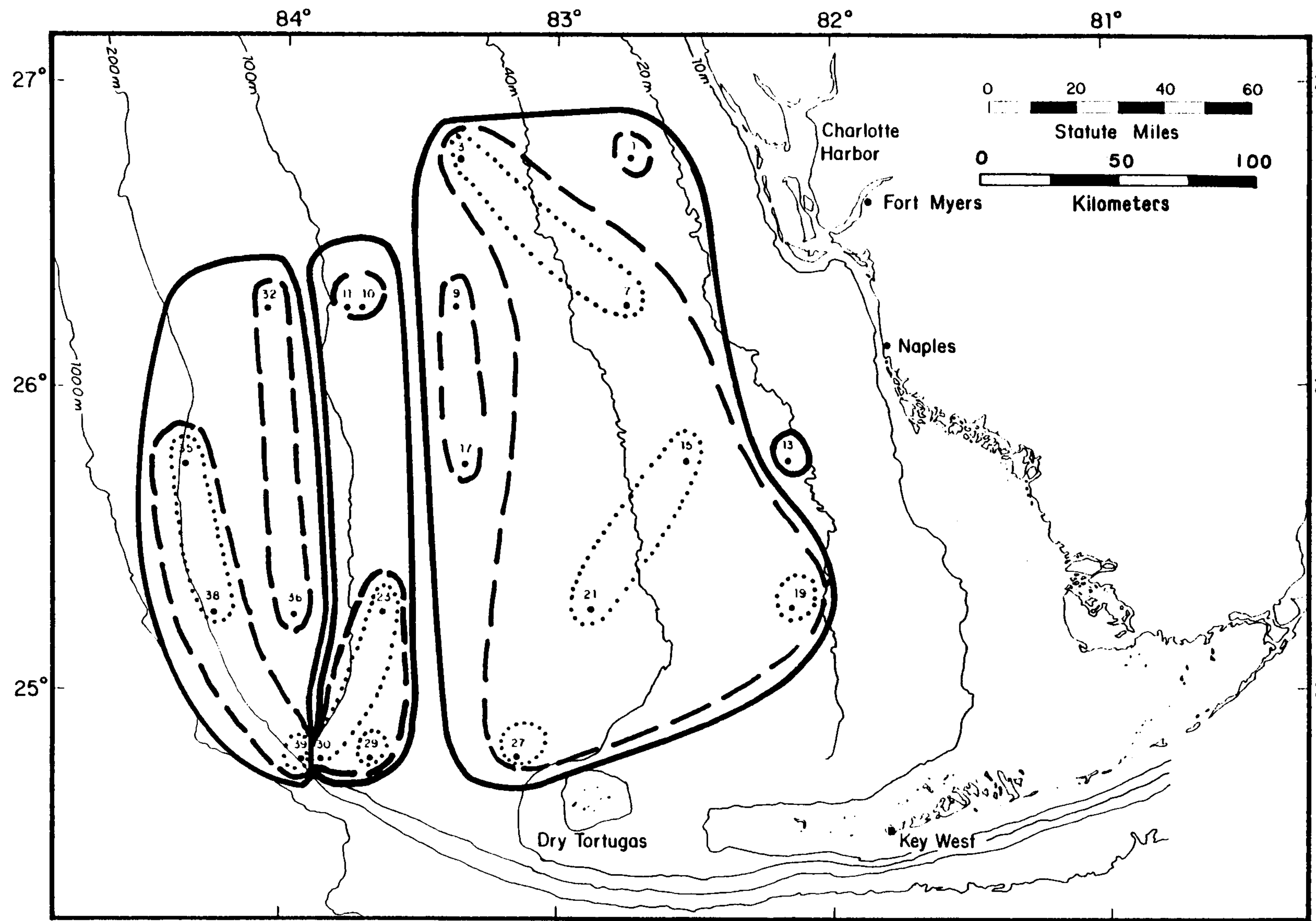


Figure 6-6. Live bottom station groupings based on examination of QSA data. See Table 6-66 for additional information concerning the basis of station groupings.

Table 6-66. Summary of distinguishing characteristics used to group live bottom stations on the basis of quantitative slide analysis (QSA) data.

Distinguishing Characteristics	STATIONS 13	1	3	7	15	21	19	27	9	17	10	11	23	30	29	32	36	35	38	39
High gorgonian cover; blue-green algal dominance in summer	+																			
Mixed sponge-algal assemblages; mostly seasonal algae, with some perennials		+	+	+	+	+	+	+	+	+										
Seasonal algae very abundant, all seasons; sponge cover low		+																		
Sponge cover dominant, most seasons			+	+	+	+	+	+												
High levels of sponge cover					+	+	+													
a)-highly diverse sponge cover					+	+														
b)-sponge cover dominated by few species (<u>Geodia</u> spp.)						+														
c)-intermediate between a) and b)			+	+																
<u>Halimeda</u> sp. dominant one or several seasons; crustose red algae also present; low sponge cover; bryozoans contribute significant cover									+	+										
Coralline algae as nodules or pavement; year-round presence of red or green perennials											+	+	+	+	+					
Low cover by algal nodules and red cryptonemialid algae											+	+								
Presence of <u>Anadyomene menziesii</u>													+	+	+					
Coralline algae as pavement														+	+					
<u>Agaricia</u> sp. present; <u>A. menziesii</u> highly abundant															+					
Generally sparse suspension-feeding assemblages dominated by crinoids and/or sponges, soft corals, and antipatharians																+	+	+	+	+
Seasonal algae noted; cryptonemialid red algae present but low cover values																		+	+	+
Crinoid abundance very low																				+

See Figure 6-6 for a station map showing these groupings.

Table 6-67. Summary of Inclusion Criteria for Live Bottom Biological Data used in Cluster Analyses.

	TYPE OF DATA						
	OTTER TRAWL			TRIANGLE DREDGE			
				Inclusion Criteria			
CRUISE	Inclusion Criterion (No. Stations/ Total Possible)	Total No. of Genus or Species-Level Taxa Collected	No. of Taxa Included in Cluster Analysis	(No. Stations/ Total Possible)	(No. Dredge Samples/Total Possible)	Total No. of Genus or Species-Level Taxa Collected	No. of Taxa Included in Cluster Analysis
Fall	4/14*	557	104	6/15	10/45	768	116
Spring	4/15	565	110	6/15	9/45	798	113
Summer	3/14	530	92	6/14	7/42	861	109
Winter	3/14	509	106	6/14	7/42	727	107
All Cruises**	10/57	1,089	111	16/58	24/174	1,461	143

EXPLANATION: Because far more taxa were collected than could feasibly be included in cluster analyses (due to computer program limitations), each data set was truncated by including only genus- or species-level taxa having at least some minimum frequency of occurrence. For otter trawl data (one sample per station), inclusion was based on number of station occurrences. For triangle dredge data (three samples per station), an either/or criterion was applied using number of station occurrences and number of dredge sample occurrences. For example, a taxon would be included in the Fall Cruise analysis if it occurred at 6 or more of 15 stations or in 10 or more of 45 total dredge samples. There is no special significance to these criteria; they were selected by examining ranked frequency of occurrence tables and choosing a cutoff point that would limit the data base to about 100 to 150 taxa.

*There was no Fall Cruise otter trawl sample from Station 21.

**All Cruises: This analysis used each station/cruise as a separate entity.

distributed taxa inevitably results in an overemphasis of similarity between stations, possibly reducing our ability to delineate faunal zones.

In the sections that follow, cluster diagrams are shown with different kinds of lines used to indicate different levels of similarity, as illustrated in Figure 6-7. Also, the terms "unique" and "characteristic" are used in reference to taxa associated with particular clusters. In this context, a taxon is "unique" to a cluster if it occurs only in that cluster. "Characteristic" taxa are those exhibiting a high degree of constancy and fidelity for stations in a particular cluster--i.e., those that occur at most stations in a cluster but not at most other stations. These observations were made by examining two-way tables of species and station groupings from normal and inverse clustering. No formal nodal analyses were conducted.

Results are discussed below in the order in which the cruises were conducted (fall, spring, summer, and winter, respectively).

6.4.3.1 Triangle Dredge Data

A total of 1,544 taxa were collected from dredge samples on the four biological sampling cruises; of these, 1,461 (95%) were identified to genus or species level (a prerequisite for inclusion in cluster analyses). Most of those specimens not identified to genus or species were sponges. Of the total taxa identified to genus or species, 280 (19.2%) were molluscs, 249 (17.1%) were crustaceans, 241 (16.5%) were sponges, 159 (10.9%) were cnidarians, 149 (10.2%) were algae (including 38 chlorophytes, 84 rhodophytes, and 27 phaeophytes), and 116 (8.0%) were echinoderms. These groups accounted for 82% of all dredge-collected taxa. The most frequently captured representatives of some major groups are listed in Table 6-68. Tables 6-69 through 6-73 summarize the total number of taxa identified to genus or species level collected from each station on each of the four cruises and for all cruises combined, broken down by major phyletic groups. The number of taxa collected by dredge at individual stations on all four cruises combined varied from 412 (Station 3) to 123 (Station 35); generally, species richness was highest at stations in depths of less than 50m and lowest at the deep offshore stations (Stations 32, 35, 36, and 38) and

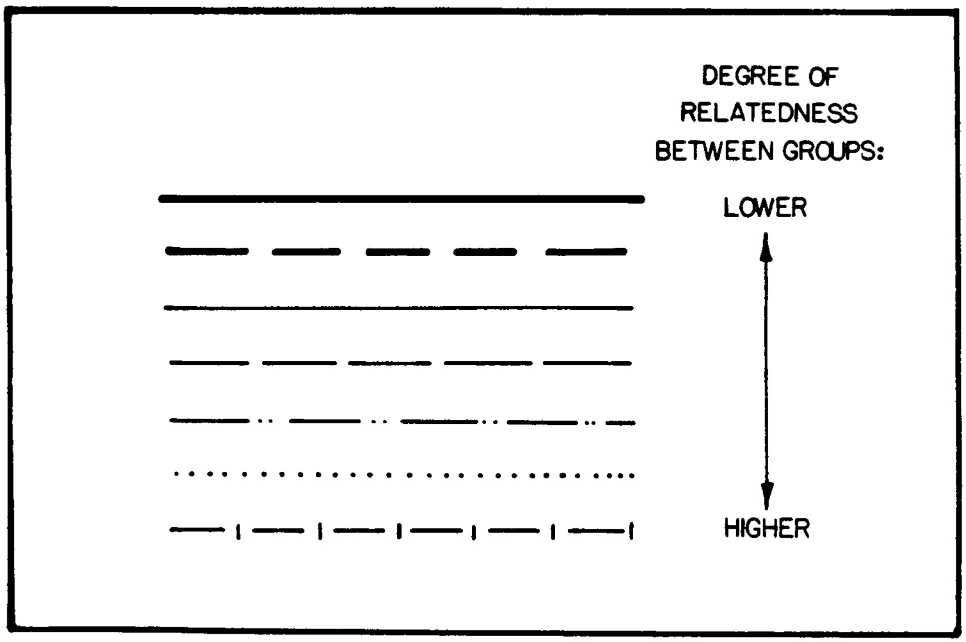


Figure 6-7. Line symbols used to denote different levels of similarity in triangle dredge and otter trawl cluster analysis diagrams.

Note: Line weights do not reflect fixed similarity values. See Section 3.4.2.3 for further information concerning cluster analysis and individual dendrograms for specific similarity values.

Table 6-68. The five most frequently captured taxa within each major group, from triangle dredge data. The number of station/season occurrences (out of a possible maximum of 58) is given in parentheses. Only taxa identified to genus or species are included.

SPONGES		CRUSTACEANS		ANTHOZOANS	
Placospongia melobesioides	(39)	Stenorhynchus seticornis	(40)	Madracis asperula	(23)
Cinachyra alloclada	(35)	Phimochirus holthuisi	(37)	Siderastrea radians	(22)
Geodia neptuni	(35)	Dromidia antillensis	(37)	Phyllangia americana	(17)
Ircinia strobilina	(32)	Paguristes sericeus	(36)	Scolymia lacera	(16)
Anthosigmella varians	(24)	Parthenope fraterculus	(29)	Manicina areolata	(16)
MOLLUSCS		**ALGAE**		**ECHINODERMS**	
Turritella acropora	(33)	Halimeda gracilis	(38)	Ophiothrix angulata	(53)
Laevicardium pictum	(27)	Lithothamnium calcareum	(33)	Arbacia punctulata	(32)
Vermicularia knorii	(24)	L. ruptile	(27)	Ophiolepis elegans	(29)
Murex rubidis	(23)	Peyssonnelia rubra	(24)	Astropecten duplicatus	(29)
T. exoleta	(22)	P. simulans	(17)	Ophiomyxa flaccida	(27)
BRYOZOANS		**HYDROZOANS**			
Stylopoma spongites	(45)	Thyroscyphus marginatus	(28)		
Celleporaria albirostris	(38)	Aglaophenia elongata	(20)		
C. magnifica	(34)	Eudendrium carneum	(16)		
Steganoporella magnilabris	(31)	Sertularella pinnigera	(14)		
Bugula neritina	(23)	Dynamena pourtalesi	(14)		

Table 6-69. Fall Cruise: Number of taxa identified to genus or species level captured by Trangle Dredge. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	11	8	4	7	4	0	10	2	5	9
PHAEOPHYCOPHYTA	3	2	1	5	1	0	2	0	3	2
RHODOPHYCOPHYTA	16	5	9	7	8	5	13	4	9	7
PORIFERA	19	43	36	13	50	46	36	70	36	19
CNIDARIA	10	13	18	10	13	17	16	13	9	7
MOLLUSCA	12	22	19	31	13	12	46	24	37	26
ARTHROPODA-MANDIBULATA-CRUSTACEA	38	37	27	41	35	26	40	50	37	40
ECTOPROCTA	10	17	6	24	9	8	7	7	18	10
ECHINODERMATA	11	11	10	15	17	13	18	9	19	19
CHORDATA-UROCHORDATA	2	5	7	3	3	2	9	5	5	2
CHORDATA-GNATHOSTOMATA	7	8	6	7	14	3	13	5	9	11
ALL OTHERS	4	1	1	3	0	0	1	0	3	3
*TOTAL FALL CRUISE	143	172	144	166	167	132	211	189	190	155

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA	6	5	3	3	3				
PHAEOPHYCOPHYTA	0	0	1	0	0				
RHODOPHYCOPHYTA	9	7	4	3	2				
PORIFERA	59	20	25	26	39				
CNIDARIA	8	5	8	15	12				
MOLLUSCA	21	8	24	7	3				
ARTHROPODA-MANDIBULATA-CRUSTACEA	46	12	24	9	12				
ECTOPROCTA	7	3	10	3	5				
ECHINODERMATA	8	12	15	16	8				
CHORDATA-UROCHORDATA	5	3	2	5	1				
CHORDATA-GNATHOSTOMATA	13	3	11	3	2				
ALL OTHERS	1	1	0	2	2				
*TOTAL FALL CRUISE	183	79	127	92	89				

Blank columns indicate no sample taken.

Table 6-70. Spring Cruise: Number of taxa identified to genus or species level captured by Triangle Dredge. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	9	3	3	4	3	2	2	3	2	3
PHAEOPHYCOPHYTA	3	0	3	1	0	0	1	0	0	1
RHODOPHYCOPHYTA	12	6	11	3	5	7	3	5	2	3
PORIFERA	17	25	29	16	27	39	20	52	25	23
CNIDARIA	8	10	21	10	12	10	17	13	11	11
MOLLUSCA	23	28	36	32	11	20	30	30	42	32
ARTHROPODA-MANDIBULATA-CRUSTACEA	34	41	33	44	31	33	33	40	48	27
ECTOPROCTA	8	19	7	13	11	11	9	13	19	6
ECHINODERMATA	12	13	10	18	16	10	10	7	19	12
CHORDATA-UROCHORDATA	13	9	5	3	4	4	5	5	4	1
CHORDATA-GNATHOSTOMATA	7	13	8	11	4	6	7	8	19	8
ALL OTHERS	2	0	3	2	0	1	1	1	2	1
*TOTAL SPRING CRUISE	148	167	169	157	124	143	138	177	193	128

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA	4	3	2	3	3				
PHAEOPHYCOPHYTA	3	1	1	0	1				
RHODOPHYCOPHYTA	13	6	1	6	5				
PORIFERA	62	16	40	23	17				
CNIDARIA	13	9	12	14	21				
MOLLUSCA	34	10	25	11	6				
ARTHROPODA-MANDIBULATA-CRUSTACEA	38	18	39	7	18				
ECTOPROCTA	14	5	15	8	9				
ECHINODERMATA	7	11	10	16	13				
CHORDATA-UROCHORDATA	12	1	5	9	1				
CHORDATA-GNATHOSTOMATA	7	4	12	11	13				
ALL OTHERS	1	0	3	0	1				
*TOTAL SPRING CRUISE	208	84	165	108	108				

Table 6-71. Summer Cruise: Number of taxa identified to genus or species level captured by Triangle Dredge. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	13	7	9	6		1	7	6		
PHAEOPHYCOPHYTA	11	3	7	3		2	5	1		
RHODOPHYCOPHYTA	22	8	16	5		5	6	12		
PORIFERA	22	34	50	6		37	19	40		
CNIDARIA	7	28	19	8		14	10	9		
MOLLUSCA	28	40	46	30		12	27	18		
ARTHROPODA-MANDIBULATA-CRUSTACEA	23	41	43	36		41	41	17		
ECTOPROCTA	6	18	13	17		10	8	4		
ECHINODERMATA	11	11	10	15		12	10	7		
CHORDATA-UROCHORDATA	8	11	13	5		2	5	4		
CHORDATA-GNATHOSTOMATA	17	10	14	7		5	11	5		
ALL OTHERS	3	2	2	2		0	2	0		
*TOTAL SUMMER CRUISE	171	213	242	140		141	151	123		

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA	4	5		6		0	0	0	0
PHAEOPHYCOPHYTA	5	1		2		1	1	1	1
RHODOPHYCOPHYTA	5	7		5		1	0	1	0
PORIFERA	51	23		31		24	15	13	16
CNIDARIA	7	2		21		7	28	27	25
MOLLUSCA	28	12		16		8	6	13	11
ARTHROPODA-MANDIBULATA-CRUSTACEA	27	19		11		21	6	21	14
ECTOPROCTA	6	3		6		8	2	1	2
ECHINODERMATA	10	17		23		9	18	19	17
CHORDATA-UROCHORDATA	7	2		5		1	1	3	1
CHORDATA-GNATHOSTOMATA	8	4		8		2	3	4	3
ALL OTHERS	1	0		2		1	2	1	1
*TOTAL SUMMER CRUISE	159	95		136		83	82	104	91

Table 6-72. Winter Cruise: Number of taxa identified to genus or species level captured by Triangle Dredge. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	10	3	3	4		2	6	4		
PHAEOPHYCOPHYTA	1	0	1	1		2	1	0		
RHODOPHYCOPHYTA	7	4	6	4		8	2	3		
PORIFERA	12	31	29	5		22	17	42		
CNIDARIA	8	6	12	7		11	9	12		
MOLLUSCA	38	44	35	34		15	38	36		
ARTHROPODA-MANDIBULATA-CRUSTACEA	33	41	21	41		25	31	29		
ECTOPROCTA	6	9	8	11		2	5	7		
ECHINODERMATA	14	12	9	17		8	15	8		
CHORDATA-UROCHORDATA	10	6	10	3		3	4	3		
CHORDATA-GNATHOSTOMATA	8	6	2	10		7	6	15		
ALL OTHERS	1	0	2	2		0	3	2		
*TOTAL WINTER CRUISE	148	162	138	139		105	137	161		

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA	2	3		3		0	0	0	0
PHAEOPHYCOPHYTA	0	2		1		0	0	0	0
RHODOPHYCOPHYTA	2	5		4		0	0	0	0
PORIFERA	49	17		22		15	7	11	18
CNIDARIA	6	5		17		10	23	24	26
MOLLUSCA	24	12		7		15	10	11	4
ARTHROPODA-MANDIBULATA-CRUSTACEA	33	12		2		27	12	25	10
ECTOPROCTA	6	5		2		5	1	0	2
ECHINODERMATA	9	15		16		19	18	19	22
CHORDATA-UROCHORDATA	5	1		5		0	1	2	0
CHORDATA-GNATHOSTOMATA	8	5		4		9	2	5	2
ALL OTHERS	0	0		2		0	0	1	1
*TOTAL WINTER CRUISE	144	82		85		100	74	98	85

Table 6-73. All Cruises combined: Number of taxa identified to genus or species level captured by Triangle Dredge. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	23	10	12	10	4	4	16	9	5	9
PHAEOPHYCOPHYTA	15	5	10	10	1	3	8	1	3	3
RHODOPHYCOPHYTA	38	18	30	13	10	14	20	16	10	8
PORIFERA	41	79	77	28	61	81	56	102	51	35
CNIDARIA	14	37	36	17	18	30	29	23	13	13
MOLLUSCA	63	86	81	68	22	39	78	67	61	43
ARTHROPODA-MANDIBULATA-CRUSTACEA	65	71	65	81	51	66	72	72	59	52
ECTOPROCTA	17	28	16	29	15	18	15	15	25	12
ECHINODERMATA	24	27	16	28	23	25	29	17	23	24
CHORDATA-UROCHORDATA	22	17	21	6	6	7	17	11	7	3
CHORDATA-GNATHOSTOMATA	29	31	25	27	17	16	29	26	25	18
ALL OTHERS	6	3	4	5	0	1	5	3	4	3
TOTAL	357	412	393	322	228	304	374	362	286	223

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA	10	6	3	7	3	0	0	0	0
PHAEOPHYCOPHYTA	8	3	2	2	1	1	1	1	1
RHODOPHYCOPHYTA	23	16	4	10	5	1	0	1	0
PORIFERA	122	52	56	65	47	30	20	23	28
CNIDARIA	19	15	15	37	26	14	36	34	33
MOLLUSCA	64	32	40	28	8	18	15	23	13
ARTHROPODA-MANDIBULATA-CRUSTACEA	77	39	45	16	23	34	16	36	20
ECTOPROCTA	15	9	16	11	11	12	2	1	2
ECHINODERMATA	17	28	21	34	17	20	24	25	24
CHORDATA-UROCHORDATA	18	4	6	17	2	1	2	5	1
CHORDATA-GNATHOSTOMATA	26	13	19	16	14	11	5	8	4
ALL OTHERS	2	1	3	2	3	1	2	2	1
TOTAL	401	218	230	245	160	143	123	159	127

those in the southwest portion of the study area (Stations 23, 27, 29, and 30) (Figure 6-8). The low number of total taxa collected at Stations 32, 35, 36, and 38 is not simply due to their being sampled on only two cruises; the total number of taxa collected on each cruise was generally low at these stations. Similar general trends are evident in the number of dredge-collected crustaceans, sponges, molluscs, and algae (see Table 6-73).

Triangle dredge clustering results for the Fall Cruise are shown in Figure 6-9. Two major station groupings were evident. The offshore group consisted of stations at 62 to 77m depth, including Stations 10, 11, 23, 29, and 30. The ophiuroid Ophioderma rubicundum and the decapod crustacean Micropanope sculptipes were unique to the offshore group; the stomatopod Gonodactylus torus and the echinoid Stylocidaris affinis were also very characteristic of the stations in this group. The inshore group consisted of stations at 20 to 58m depth, and included two subclusters: a mid shelf cluster (Stations 3, 9, 17, and 27) at 50 to 58m depth and an inner shelf cluster (Stations 1, 7, 13, 15, 19, and 21) at 20 to 44m depth. About 20 species were unique to the inshore group as a whole; the bryozoans Nellia oculata and Celleporaria magnifica, the asteroid Astropecten duplicatus, the decapod crustacean Paguristes sericeus, and the sponge Cinachyra alloclada were characteristic of the major inshore station group. Several species were unique to and characteristic of the inner shelf subcluster, including the echinoid Lytechinus variegatus carolinus, the hard coral Cladocora arbuscula, the decapods Paguristes tortugae, Mithrax (Mithrax) pleuracanthus, Macrocoeloma trispinosum, Pilumnus sayi and Mithrax (Mithraculus) forceps, and the stomatopod Gonodactylus bredini. Three species were characteristic of the mid shelf subcluster, which appeared intermediate in taxonomic composition between the inner shelf subcluster and the offshore group: the bryozoan Bracebridgia subsulcata, the hard coral Oculina tenella, and the crustacean Callidactylus asper.

A similar pattern was observed for the Spring Cruise (Figure 6-10). The basic offshore and inshore groupings were exactly as for the Fall Cruise. However, the inshore subclusters were slightly different; Station 21 clustered with the mid shelf group rather than the inner shelf group. Within the offshore group, Gonodactylus torus and Ophioderma rubicundum were again unique; in addition,

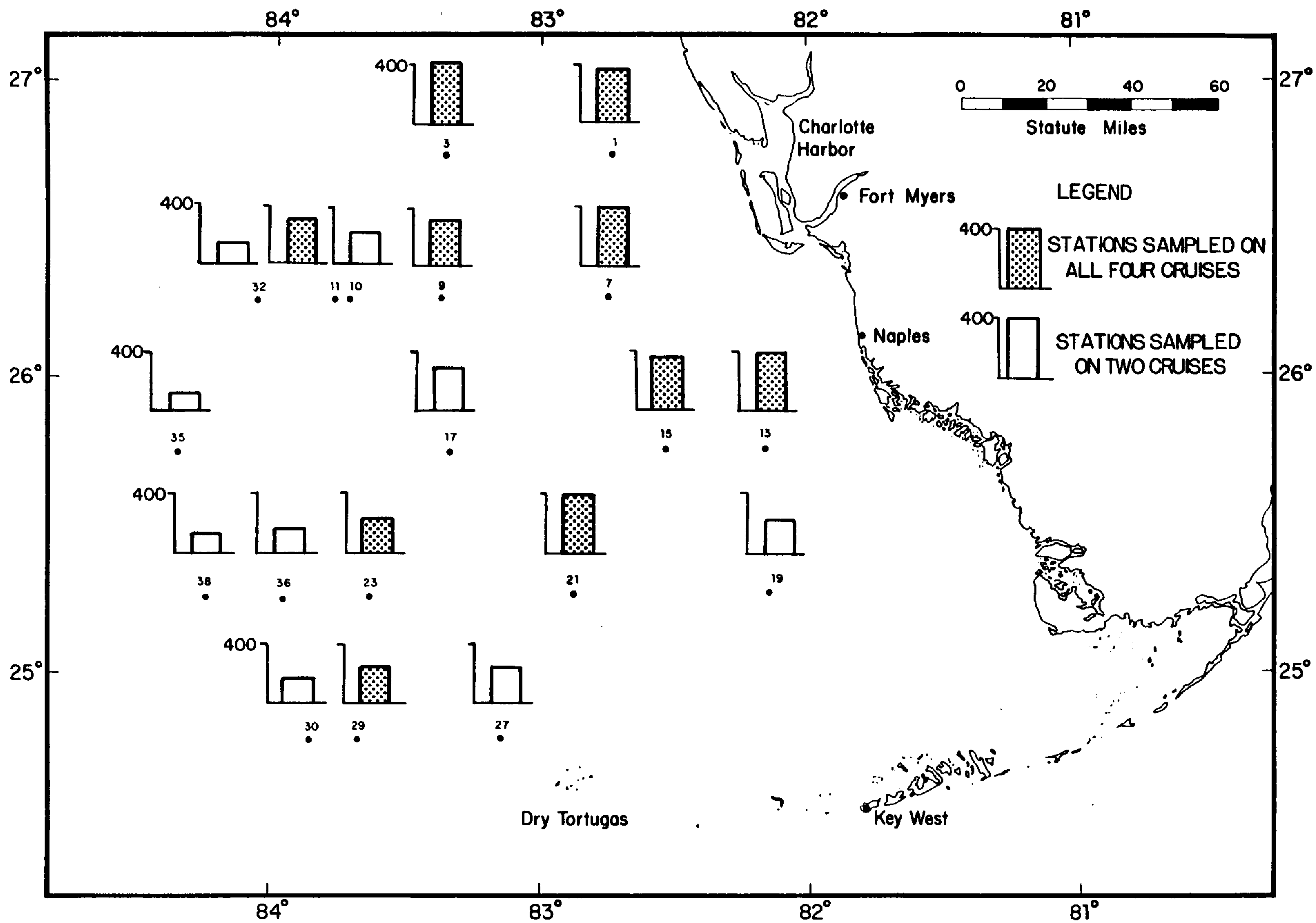


Figure 6-8. Shelfwide variation in the number of triangle dredge taxa (identified to genus or species) collected at live bottom stations.

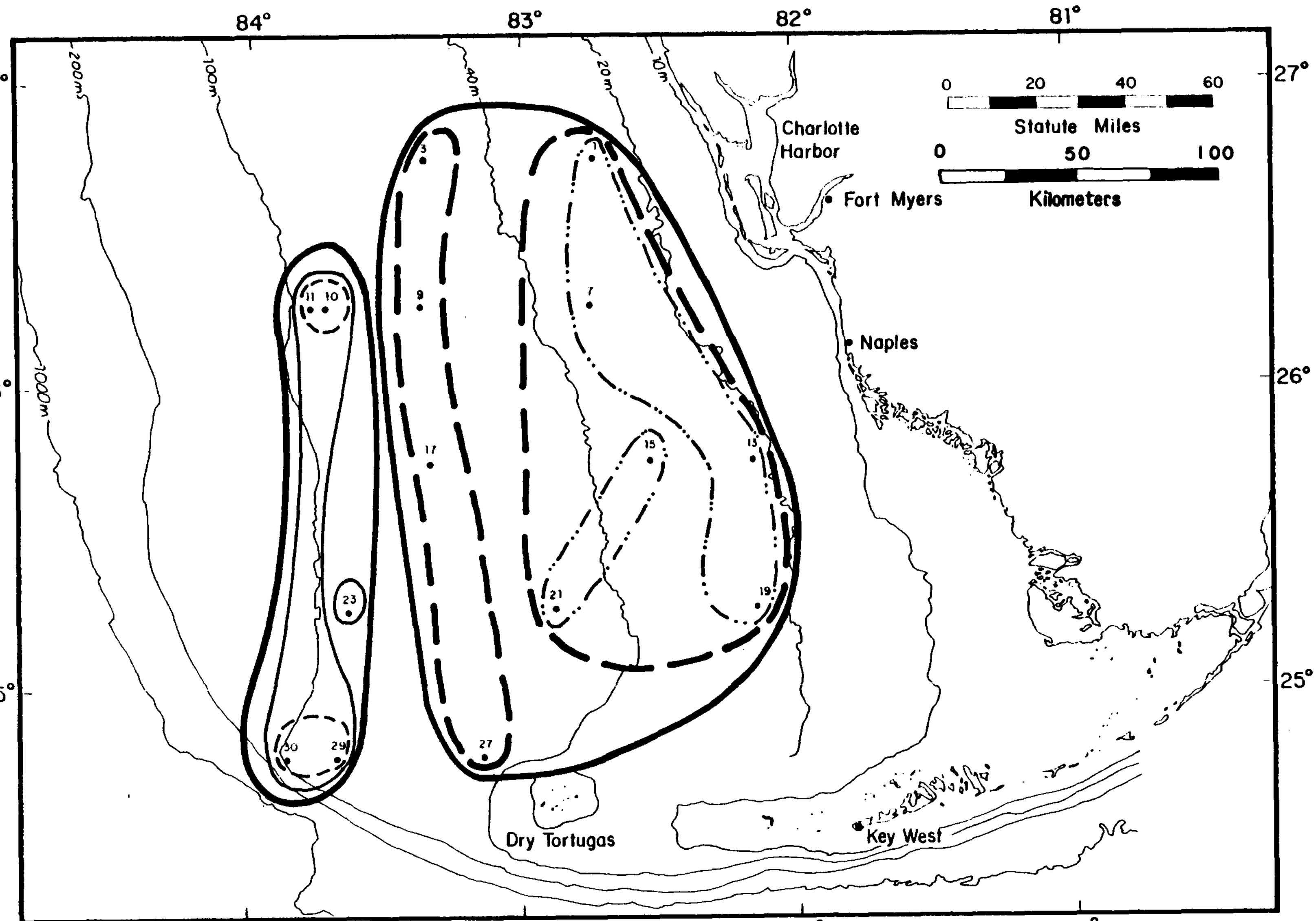


Figure 6-9. Station groupings from cluster analysis triangle dredge data, Fall Cruise.

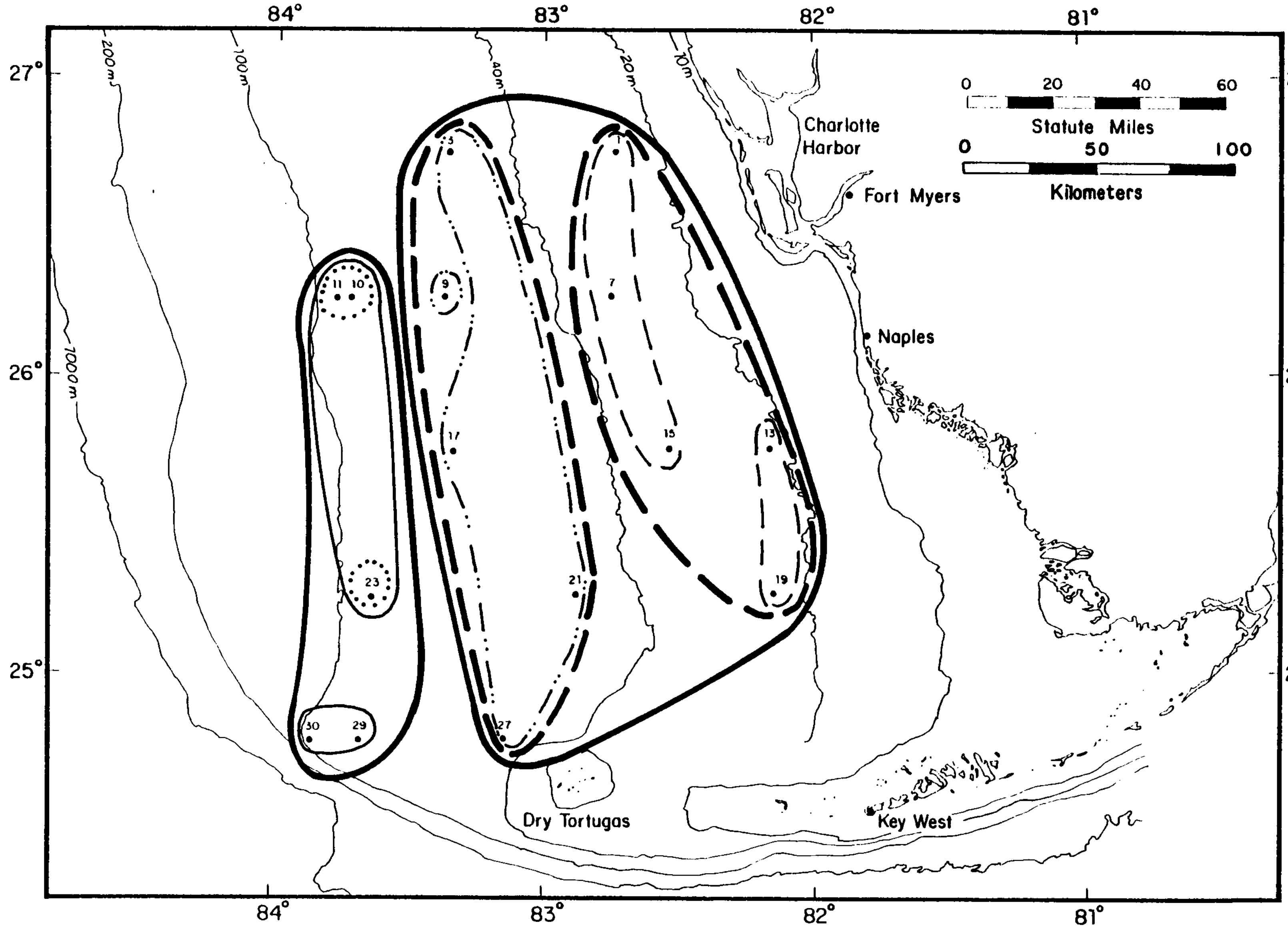


Figure 6-10. Station groupings from cluster analysis of triangle dredge data, Spring Cruise.

the crustose red alga Peyssonnelia rubra was characteristic of stations in this group. The subclustering of Stations 29 and 30 in the southern part of the offshore group appeared to reflect affinities of the remaining offshore stations with stations in the inshore group (e.g., Stations 9 and 17). Thirty species were unique to the major inshore group. Characteristic species included the decapod crustacean Paguristes sericeus, the echinoid Clypeaster subdepressus, the bivalve Aequipecten muscosus, and the sponge Anthosigmella varians. Species unique to and characteristic of the mid shelf subcluster were the decapod Iliacantha sparsa, the gastropod Polystira albida, and the echinoid Genocidaris maculata. No species were unique to the inner shelf subcluster, but the hard coral Siderastrea radians, the algae Laurencia intricata and Udotea conglutinata, the stomatopod Gonodactylus bredini, and the decapod Mithrax (Mithrax) pleuracanthus were characteristic of the stations in this group. Some additional subclustering was evident within the inner shelf subgroup, apparently related to depth and/or latitude.

The major groupings for the Summer Cruise (Figure 6-11) were similar to those observed for the Spring Cruise. The additional deep Stations 32, 35, 36, and 38 clustered (as expected) with the offshore group (no triangle dredge data were obtained for Station 39). Thirteen species, including several ophiuroids, echinoids, hard corals, and crustaceans and a sponge and bivalve, were unique to the offshore group; characteristic species included the decapod Micropanope sculptipes and the echinoid Stylocidaris affinis. Species characteristic of the outer subgroup [Stations 32, 35, 36, 38, and (oddly) Station 11] included the sponge Mycale sp., the hard coral Madrepora carolina, the hydroid Acryptolaria conferta, the bivalve Aequipecten phrygium, the decapod Osachila tuberosa, and the ophiuroids Ophioplax sp. B and Ophiomusium sp. A. The subclustering of Stations 23 and 29 appears to reflect biotal composition with species in common with both deeper and shallower stations rather than distinctly unique biota. Thirty-three species, including seven sponges, three corals, and four crustaceans, were unique to the major inshore group; the bivalve Laevicardium pictum, the decapod Paguristes sericeus, and the echinoid Lytechinus variegatus carolinus were particularly characteristic of the group. The inner shelf subcluster had five unique species: the brown alga Rosenvingea intricata and the red alga Gracilaria blodgetti, the hard corals Solenastrea

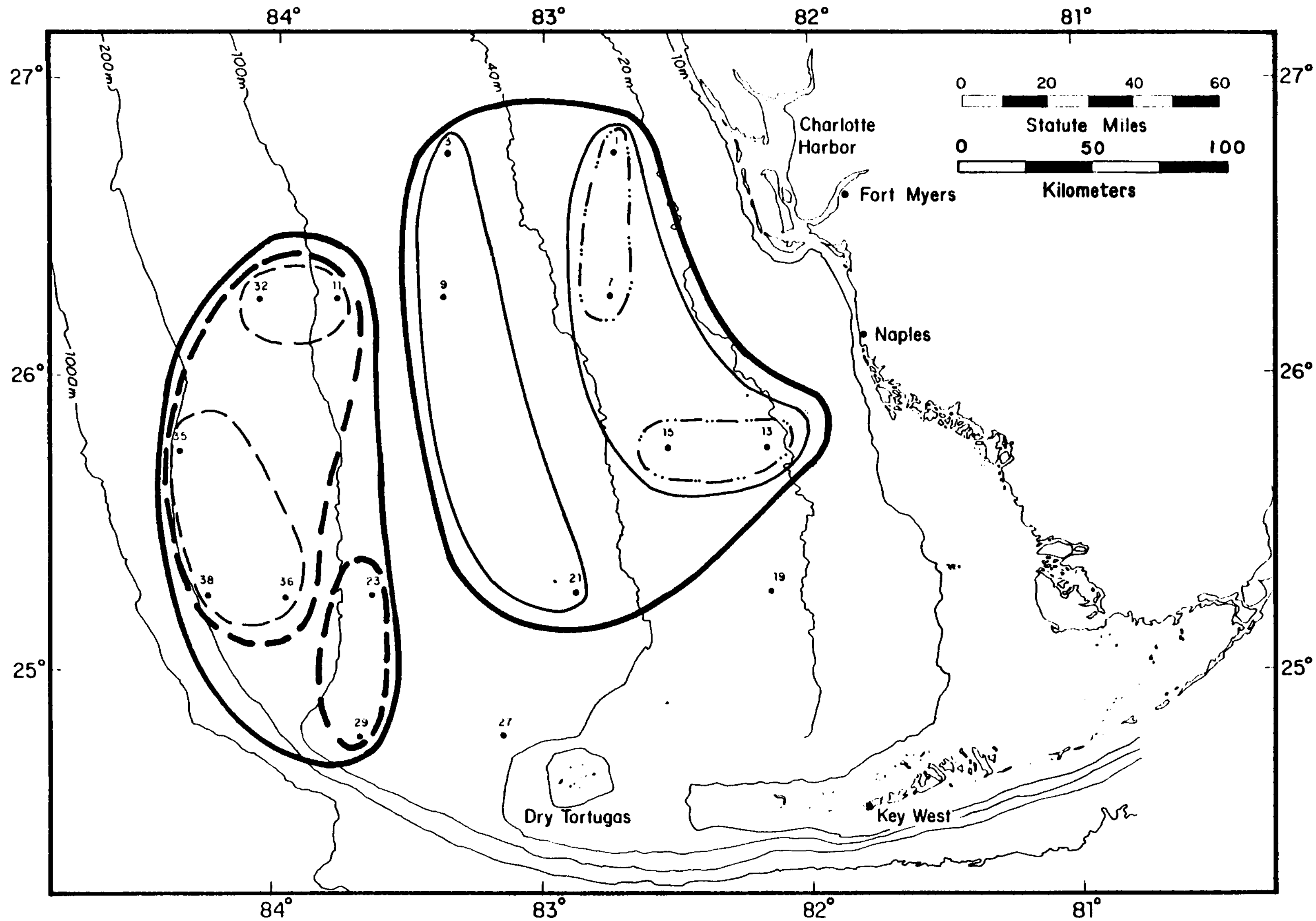


Figure 6-11. Station groupings from cluster analysis of triangle dredge data, Summer Cruise.

hyades and Cladocora arbuscula, and the decapod Pilumnus sayi. No species were unique to the mid shelf subcluster, which appeared intermediate in taxonomic composition between the inner shelf subcluster and the offshore group.

Clustering of dredge samples for the Winter Cruise (Figure 6-12) showed the same basic offshore and inshore groups. However, further subclustering subdivided the offshore group into an outer group (Stations 32, 35, 36, and 38) in 127 to 159m depth and an inner group (Stations 11, 23, and 29) in 62 to 77m depths. Sixteen species were unique to the offshore group as a whole; the most characteristic species of the station grouping were the soft coral Nicella guadalupensis, the hard coral Madracis asperula, and the echinoid Stylocidaris affinis. Seven species were unique to the outer subgroup, including the asteroids Pectinaster mixtus and Rosaster alexandri, the crinoid Neocomatella pulchella, the ophiuroid Ophiomusium sp. A, the corals Javania cailleti and Caryophyllia horologium, and the hydroid Zygophalax convallaria. No species were unique to the inner subcluster of the offshore group, which appeared intermediate in taxonomic composition between inshore and outer offshore groups. The inshore group (Stations 1, 3, 7, 9, 13, 15, and 21) was distinguished by 36 unique species; those most characteristic of the group as a whole included the bryozoans Celleporaria magnifica and C. albirostris, the sponge Cinachyra alloclada, the decapod crustaceans Dromidia antillensis, Synalpheus townsendi (alpheid shrimp), and Paguristes sericeus, the asteroid Astropecten duplicatus, and the ophiuroid Ophiolepis elegans. The inner shelf subcluster (Stations 1, 7, 13, 15, and 21; depth range 20 to 32m) was distinguished by the presence of the bivalves Tellina listeri, Aequipecten muscosus, and Macrocallista maculata, the hard corals Solenastrea hyades, Cladocora arbuscula, and Stephanocoenia michelinii, the sponge Axinella polycapella, and the hemichordate Rhabdopleura compacta. The mid shelf subcluster (Stations 3, 9, and 21; depth range 44 to 56m) had no unique species and appeared intermediate in taxonomic composition between inner inshore and offshore groups.

When data from all cruises are included, the results (Figure 6-13) illustrate the overall grouping into offshore (62 to 159m depth) and inshore (20 to 58m depth) clusters. Within each major grouping, depth-related subclusters are evident. In the inshore group, Stations 1, 7, 13, 15, and 19 formed an inner

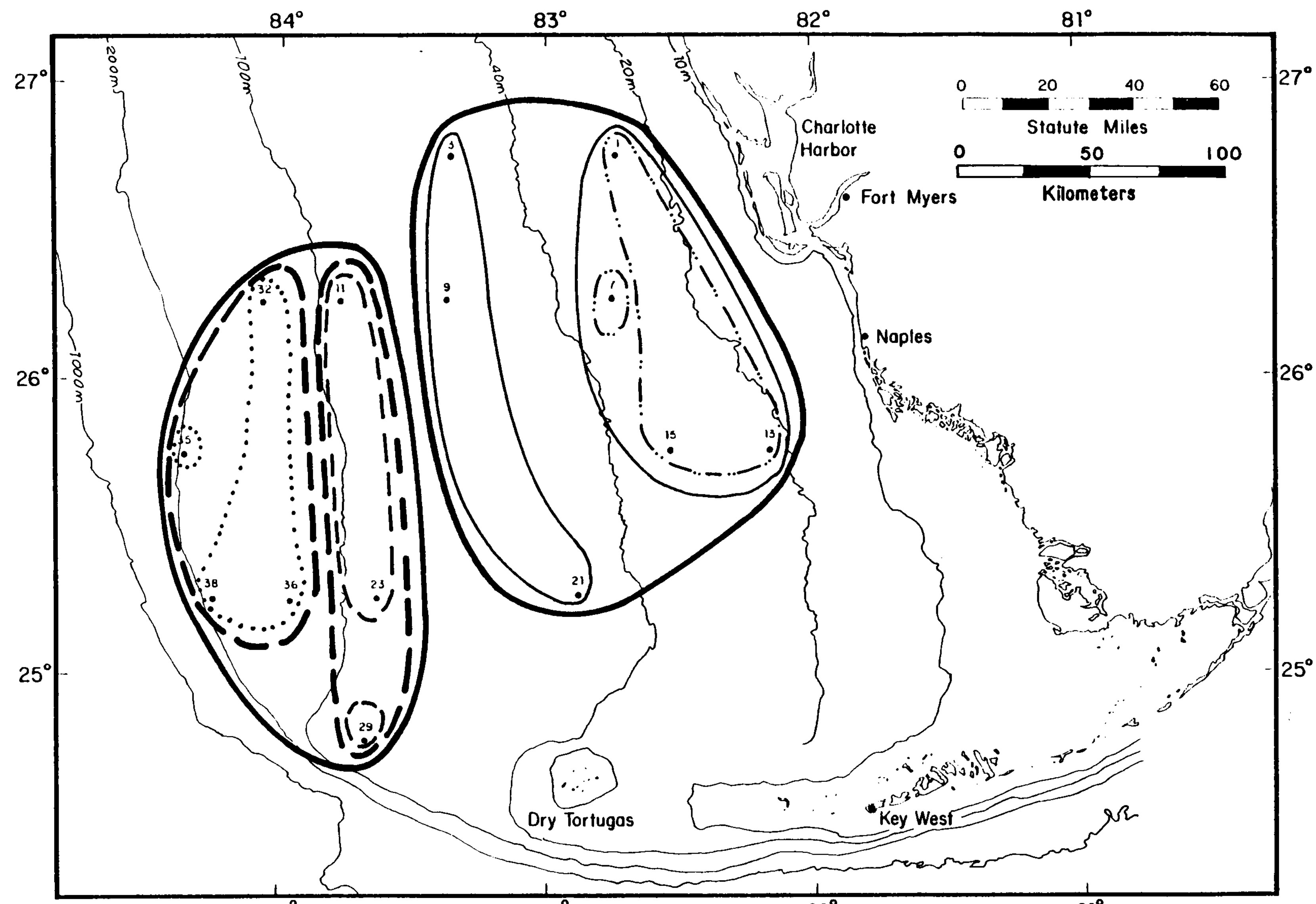


Figure 6-12. Station groupings from cluster analysis of triangle dredge data, Winter Cruise.

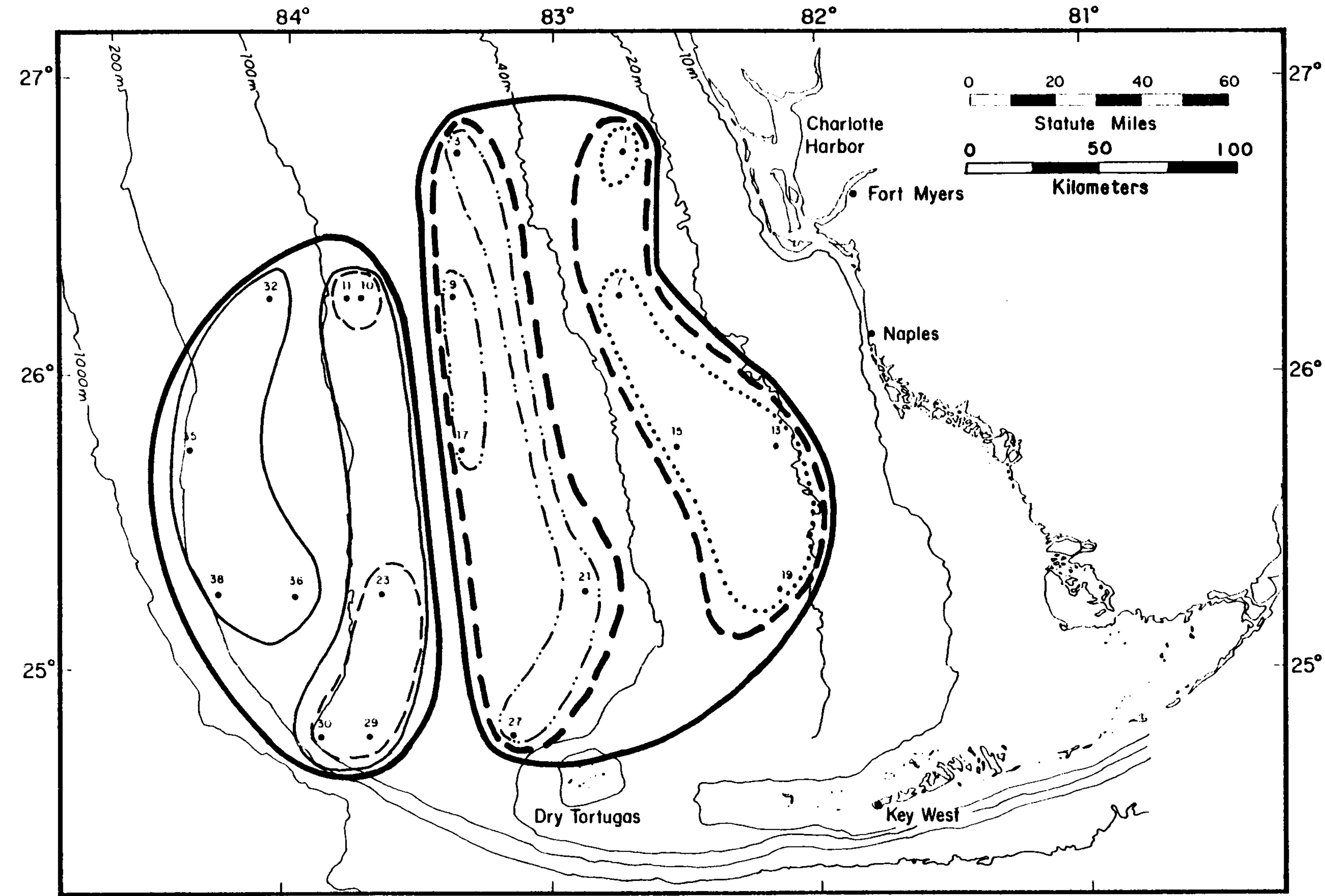


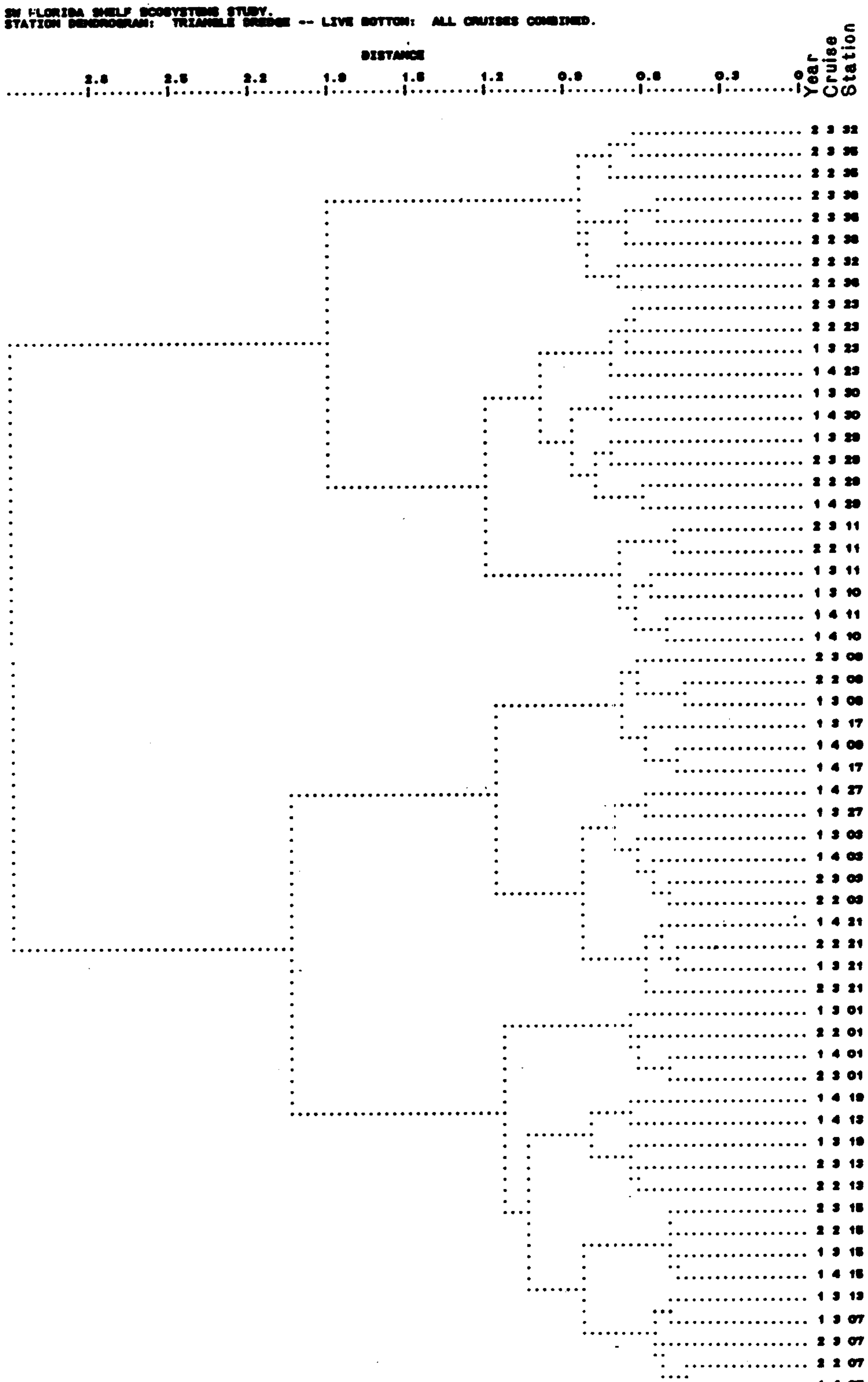
Figure 6-13. Station groupings from cluster analysis of triangle dredge data, all cruises.

shelf subcluster (20 to 32m depth) and Stations 3, 9, 17, 21, and 27 formed a mid shelf subcluster (44 to 58m depth). Within the offshore group, Stations 10, 11, 29, and 30 formed an inner subcluster (depth 62 to 77m), whereas Stations 32, 35, 36, and 38 formed an outer subgroup in 137 to 159m depth. Species characteristic of the offshore group as a whole included the ophiuroid *Ophioderma rubicundum* and the asteroid *Poraniella regularis*, the crustaceans *Gonodactylus torus* (stomatopod) and *Micropanope sculptipes* (decapod), the green algae *Anadyomene menziesii* and Palmellaceae n. sp., and the sponge *Discodermia* sp. All except *Discodermia* sp. and *M. sculptipes* were characteristic of the inner subgroup. Taxa with strong fidelity for the deep offshore stations did not show up in this analysis because of the more stringent inclusion criteria for the "all cruises combined" analysis. Thirteen species were unique to the major inshore group; the most characteristic of the group as a whole were the bivalves *Aequipecten muscosus* and *Laevicardium pictum*, the decapod *Paguristes sericeus*, and the echinoid *Clypeaster subdepressus*. Five of these were unique to the inner shelf subcluster: the crustaceans *Mithrax* (*Mithraculus*) *forceps* and *Pilumnus sayi*, the hard corals *Solenastrea hyades* and *Cladocora arbuscula*, and the bivalve *Macrocallista maculata*. No species were unique to the mid shelf subcluster, which, as expected, appeared intermediate in composition between inner shelf and offshore groups.

Figure 6-14 shows the station dendrogram for the "all cruises" analysis, and Table 6-74 is the corresponding two-way table for taxa and stations included in the analysis. Both stations and taxa are ordered on the basis of cluster analysis results.

Table 6-75 summarizes the taxa characteristic of particular station groupings emerging from these cluster analyses.

Summary -- The results of triangle dredge cluster analysis show a basic offshore-inshore pattern in species composition of the epibiota, with subclustering within these major groups indicative of a general depth-related gradient in species composition. The offshore cluster generally included stations in 62 to 159m depth; the inshore cluster included stations in 20 to 58m depth. Little seasonal variation in the basic pattern was noted; most seasonal samples clus-



NOTE: YEAR 1, CRUISE 3 = FALL CRUISE (OCTOBER 28-NOVEMBER 22, 1980); YEAR 1, CRUISE 4 = SPRING CRUISE (APRIL 22-MAY 5, 1981); YEAR 2, CRUISE 2 = SUMMER CRUISE (JULY 16-AUGUST 5, 1981); YEAR 2, CRUISE 3 = WINTER CRUISE (JANUARY 28-FEBRUARY 15, 1982).

Figure 6-14. Station dendrogram from cluster analysis of triangle dredge data from live bottom stations, all cruises combined.

Table 6-74. Two-way station/season occurrences of taxa at live bottom stations, based on triangle dredge sample data included in the "all cruises" cluster analysis.

```
YEAR                         2 2 2 2 2 1 1 2 1 2 1 1 2 1 1 1 1 2 2 2 2 2 1 2 2 1 1 2 1
CRUISE                       3 3 2 2 2 4 4 3 4 2 3 4 2 3 4 3 4 2 2 3 2 3 4 3 3 3 3 3 4
STATION                      3 3 3 3 2 2 3 2 2 1 1 1 0 1 1 2 0 0 2 2 0 0 1 1 1 1 1 0 0
                             5 8 8 6 3 3 0 9 9 1 0 0 9 7 7 7 3 3 1 1 1 1 3 3 5 5 3 7 7

YEAR                         2 2 2 2 2 1 1 1 2 2 1 1 2 1 1 1 1 2 1 1 1 1 1 1 2 2 1 1 2
CRUISE                       3 2 3 2 3 3 3 3 2 3 3 4 3 3 4 4 3 3 4 3 3 4 4 3 2 2 4 3 2
STATION                      3 3 3 3 2 2 3 2 2 1 1 1 0 0 0 2 0 0 2 2 0 0 1 1 1 1 1 0 0
                             2 5 6 2 3 3 0 9 9 1 1 1 9 9 9 7 3 3 1 1 1 1 9 9 3 5 5 7 7

                             123456789012345678901234567890123456789012345678901234567890123456789012345678

TAXON

MITHRAX (MITHRACULUS) FORCE                                                        +-+-   --  -+++-++    --
CLADOCORA ARBUSCULA                                                                -++--   -     --+-+++++-
PILUMNUS SAYI                                                                        ---+++++--+-++      +-
MACROCALLISTA MACULATA                                                                --++-+-+        +-++-
SOLENASTREA HYADES                                                                 ++++--    -+--     +++++
LAURENCIA INTRICATA                                                         --     ++++--             -+ ++
GONODACTYLUS BREDINI                                                      -   -++-+++++-+--++++++++-
HOMAXINELLA WALTONSMITHI                                                - -   ++++-++-- - +++--++++
SIDERASTREA RADIANS                                                     -   +-++-++++ - ---+-++++++
OXEOSTILON BURTONI                                      -               -       ----++----        -+-+-++
MITHRAX (MITHRAX) PLEURACAN          -                         -              +++  +-+--++-+++++++-+-
UDOTEA CONGLUTINATA                                                +           -   +++-++-      + +-     +-
CHAMA MACEROPHYLLA                                              -         +--   -----     -     -+++++-+-
CHICOREUS FLORIFER                      -                            --    +-    -+-    --           ++++--
BOTRYOCLADIA OCCIDENTALIS                                        -            + +-++-      -          -+ --
LYTECHINUS VARIEGATUS CAROL                                   --   +-        -++-+++++          + + -+ +-+++
ARGOPECTEN GIBBUS                                           - -   -+ -        ++   ++----+-+         -+ -++
PARTHENOPE GRANULATA                                                +-  ----+ -     ---     -      +-    ++
METAPENAEOPSIS GOODEI                                  -    -       ---   ++- - ++ ++      + + ---+      +-
PETROCHIRUS DIOGENES                                          -   +    - +--- +         -  ---    -- +-+-
PORTUNUS ORDWAYI                                      - - --      -     ++--- ---      + - ++    ----+-++
ILIACANTHA INTERMEDIA                                              --     -           ------+     +--- --
LUIDIA ALTERNATA                                              +           --      -- ---    +-      ---+--
RHABDOPLEURA COMPACTA                                          +-   --       -     ++++ - - -          ++++
CHIONE LATILIRATA                                             --- -+ -     -      -- -+++ + -         -++++
UDOTEA CYATHIFORMIS                                        -   -+ -      +   +     ++++- --+         +   -
CLAVELINA GIGANTEA                                    -                    - --+ +-               ++ -++--
OCULINA DIFFUSA                  -                                        - -+-+-                  +-+- +-++
SCOLYMIA LACERA                                  - +                        - +-+          -      +++++++++-
AXINELLA POLYCAPELLA                          -    -               -     -         --++      ------ ++++
PSEUDAXINELLA LUNAECHARTA                     -     -                    +  -- + -  - -          --++-+++
AXINELLA SPP.                    -            + -                  --- -       - + --+            +++ ++-+
TIMEA ? MIXTA                      -                 +-                -+          +  +  + -  + ++++-
PHYLLANGIA AMERICANA          -      -                               -       -- -+++ -          ---++ +-
CHAMA CONGREGATA                      -       -       -   -              -        --+          -- +-+ +--
SPHECIOSPONGIA VESPARIUM                         -                   -   --++-++       -++--+-+++       -
ANTHOSIGMELLA VARIANS                       -               -     - --    ---++++       +++++-++++       --
SPIRASTRELLA COCCINEA                           -         -       - -- +- +-+++                -+++----+-
CIGCLISULA CF. TURRITA                   -              -           +++-+ +-+-               ++++     -++
APLYSINA FISTULARIS V. FULV                      -         -     -   +   +++-+ +       -+ - ++-+
AIOLOCHROIA CRASSA                                --     -       - --    +-+++++     - - --++++-
NIPHATES ERECTA                           + - -                      ---++-++++             --+++++
PILUMNUS FLORIDANUS                                          ++---++-+--+++++           -    ---++      -+
PALICUS ALTERNATUS                                            +---+--++ +-++ ---                 -      ++
STENOCIONOPS FURCATA FURCAT                               + --     ++-++--+ +-++                    --+ - +-
CYSTODICTYON PAVONIUM                                        -             ++++++++        -  -
PECTEN RAVENELI                                              -        +-     --- +      - +- --          - +--
CLYPEASTER SUBDEPRESSUS                                          -+ --- + -      ++ +    +-++-++++-+       ++-
AEQUIPECTEN MUSCOSUS                                              +-+++-+ -      +-     --++     --+ -     ++-
PAGURISTES SERICEUS                          -             -   ++++--+++++++++-----+-+++--++++-++
LAEVICARDIUM PICTUM                         -                   +-++++ - -+ +-- - ++++-+-- ++ -+-
CUPULADRIA BIPOROSA                                         -    --+ - -- -  +  -           ++++       +- -
NELLIA OCULATA                                                   - ++-+---+--+       -++     ++--    --+
MANUCOMPLANUS CORALLINUS                                     -- +++--+++-- -         -+- -- -        +   -+--
HIPPOPORIDRA EDAX                                     -     --- + +-++-              +   -   +- -+ +     -+-
SYNALPHEUS TOWNSENDI                                      -- +-+-+---      + ++      --++-- -     +------+-
VERMICULARIA KNORII                        -            ---    -+-++ - -      +    - -   --     + +- -+-+ +
MUREX RUBIDUS                                 -            -     --+ --     --+++--+         +-- - + -      -+
CINACHYRA ALLOCLADA                               - -      --+-    -+ +--+++++++-++++-        ----+++++++
DROMIDIA ANTILLENSIS                         -    -       -- --++---+---+++++++         -++-- --++++-     +++
TURRITELLA ACROPORA                        -   -        --    + ++-+-+ -++++----          ++----++-+       -++
CELLEPORARIA MAGNIFICA                              +-  -----++++ +-+--++++++-++++-            --   -+---
AMATHIA CONVOLUTA           -                                +++ -+        +            --++ + ++     -
ASTROPECTEN DUPLICATUS            + -                        ++++-+ +-- - - - +++--++--+---++
OPHIOLEPIS ELEGANS                  -      -               + -++++++--      -   -   +++++-+---         +++++
OPSANSUS PARDUS                         -               -- -       -           +-- - -    --    - +- -
MICROCIONA SPP.                         -              ++++-         - -       +- -     -      -++-+-+ ++
? DYSIDEA SPP.                          -    - +     +-+   +++-     -++    +- --      --+++    -++++-++--
PHIMOCHIRUS HOLTHUISI                  + + - -        - + ++-+--+++++++-++++--+           +- + +-++-++
HALIMEDA GRACILIS                      ----    -     -   -+-+++++++++-- +-+--        --- +- +----+ ++
```

Table 6-74 (Continued)

```
STYLOPOMA SPONGITES                    -- -  + +----++-++++++++++++++++++++-+- --+-+++--+
THYROSCYPHUS MARGINATUS                    -+--     -   +-++-++-+++++++   - +-+-   --   -
CELLEPORARIA ALBIROSTRIS                -  --++++     -+-++-+++-++-+++++ -  + +-+++++++++
ARBACIA PUNCTULATA                      ++  -- ++   - -   + -- -+++++++++++     ----+-+++
PLACOSPONGIA MELOBESIOIDES             -----  -- --++--   -  ++-+++++++ --- --- +-++-++++
MANICINA AREOLATA                           - ++++          -+          -  -    + -- +++-
LITHOTHAMNIUM CALCAREUM                -- + +   ---+-++- ++++-+++      +-+ +++  + -+++- +
MONACANTHUS CILIATUS                     +- + --+   +   - +-- +   +    -+ +  +--   --  --
EUDENDRIUM CARNEUM                        -+-   -  -     +-    -    -  -   -+-    + --
GEODIA GIBBEROSA                                -  -+-+        +-  + +     +     -+++
STENOCIONOPS FURCATA COELAT            -    -    ----  -     -   +-+--+ --       -+++
MICROPANOPE LAEVIMANUS            -     -         - -   +    + -- +++ ++          ---+    -
HYATTELLA INTESTINALIS                  +  -        -+ +   - +      -++-          +- +
CHONDROSIA SPP.                        -- -- -    -    -           + +- +         - --  - -
? FORCEPIA SP.                      +     -         --+     ++-     +-++      -   - +
GEODIA NEPTUNI                    -     -    ---+++-++++++   - + -+-+ ++++    +++++++++--
EPIPOLASIS SPP.                   -          - -+--  ++-+      ----- +      +  - +--+
LITHOTHAMNIUM RUPTILE                  - +- +-- ++- -++    -     ++- + -  ---     ----   --
MITHRAX (MITHRAX) ACUTICORN            -++ +-+ ++ -----   --++ -+- ++++           - -
CALLIDACTYLUS ASPER                                -  + ++-+ +++++-                    +
OPHIOSTIGMA ISOCANTHA                     -         --- ---+ - -+ +  +  -      -       -
SCYLLARUS CHACEI                       -- -           +--- +++-+--++---          -  - - +
BRACEBRIDGIA SUBSULCATA                -  - -           -+++-++-+++++              --
SYMETHIS VARIOLOSA                      +          +-  +---++--  -  -              +  - -
NEMOCARDIUM TINCTUM                             --+   ++-+-+-+  +- + - -
OCTOPUS JOUBINI                         -           -  ------ + + -     --++           +
CAULERPA SERTULARIOIDES                             + -+ ++ +  +  - -   +    + -     +
PORTUNUS SPINICARPUS                 +             +- -+-- -- +++++++    +    -+         - -
BUGULA NERITINA                           -  + +  +- +----+ +- -+-+-   - +     -       - +
VERMICULARIA SPIRATA                   -      -     --+-- ---+  +-     -       - -   -
CHLAMYS BENEDICTI                       -       +-     + + +-++++ +-+++-+         -
CYPRAEA SPURCA ACICULARIS              --      --     +  -------- -++-++
GALATHEA ROSTRATA                    -      -  -      -+ -    +-+- ++++  ++            -
MUNIDA ANGULATA                         ++- -  -      -    -++-+  ++-+-- -           -
STEGANOPORELLA MAGNILABRIS             +++--+  +-  ++---++++++-+++++++-       -        +-
TURRITELLA EXOLETA                     -+--       ++  + ++-+++++++++++ -
GENOCIDARIS MACULATA                 -    -+    -   --  -++-++--++++-
EUCIDARIS TRIBULOIDES TRIBU             --  ---  - --++++++++-+   -    -
OPHIODERMA BREVISPINUM            -      --+     -    -     ++ -++          - + -+-  -- +     +
DIDEMNUM CANDIDUM                   -  --- +-+  ---++-++++++++++++++++++++  +- - --     +++++
STENORHYNCHUS SETICORNIS          - ---   +       ---+- -- +-++-+ ++ -+-++-++  ++++++++ -++  +
OPHIOTHRIX ANGULATA               -++--- -++++-  -+-+-++-+-++--+--+-++++++-+------ - +---++-
? BIEMNA SPP.                       + --    ++ + -   --++- + -+-  +- --+ ++ -  -      ++-   -
IRCINIA STROBILINA                +      --+  -+  + +++++++    + ++----+++++          --+--   -
DYSIDEA SPP.                           -+- +         ++---- +-+   -+  + +   -      - -+-    +
FUSINUS EUCOSMIUS                 -  --   -  -       +-    -+ ---     - ----                -
CARPOPORUS PAPULOSUS                    -            --+-+++ --++     ++-
AGLAOPHENIA ELONGATA                    -   - ---   +-  -+--+-++- -  --  -
PARTHENOPE AGONA                  -     +-           -- +  ---+-+---+++
MUNIDA PUSILLA                        - +  -+ -      --+++- +-+++    + +
OPHIODERMA APPRESSUM                  - ---+    -- -     -     -     ----++          + -
? EPIPOLASIS SPP.                   -+-+ --  - --- ++++          --+  + ++-      + -++- +-
? JASPIS SPP.                         +-  +-  --+++ ++++-    +    -  -+++++          --   -
STEPHANOSCYPHUS CORNIFORMIS         -  --    -+++  ---+++++ -+-++++++ +- -                - --
PEYSSONNELIA RUBRA                         +++++++ -++-++-++++--   -  -     -             -
? HALICHONDRIA SPP.                   -  - ++  -+- -     +          --  ---        -       +
PEYSSONNELIA SIMULANS                      ++ ++-++++    -     --   --    -+        -
CALAPPA ANGUSTA                   --  + -+   -       +++---      - + ++-     - --
ECHINOLAMPAS DEPRESSA             +++++-+- -         - --  ++++-+    --
? BUBARIS SPP.                    +++   ---++ +-  ++--++ +        -   -++     -
PARTHENOPE FRATERCULUS            ++ ---- -+++--     +++++---+  +--+-+--
MADRACIS ASPERULA                  + --   -++-  +-  -++++++++++---
OPHIOMYXA FLACCIDA                - +- - . -+-+--+++++++++++++++ -
TOSIA PARVA                       - ------- --       - -++   ---        -
STYLOCIDARIS AFFINIS              -+-+-++-------     ++++-++  - -
OSACHILA TUBEROSA                 +  ---++    -      +-+-++-  +
MICROPANOPE SCULPTIPES            +---++---+- +-- - --+-+-    --
DISCODERMIA SP.                   - -+-+--+ +--+-  -+ +++-
ANADYOMENE MENZIESII                       ++++++++++               -    -
PALMELLACEAE N. SP.                        ++++++-++-                    -
GONODACTYLUS TORUS                         +-+++++ +- --- +   -
OPHIODERMA RUBICUNDUM                      --+-+++-++ --+ -
PORANIELLA REGULARIS                       ++-  ----+--+- -
                                  1234567890123456789012345678901234567890123456789012345678
```

SYMBOL DEFINITIONS: ( ) = ABSENT; (.) <= 0.5W; (-) <= 1.0W; (+) <= 2.0W;

(*) > 2.0W; W = WEIGHTED SPECIES MEAN.

NOTE: YEAR 1, CRUISE 3 = FALL CRUISE (OCTOBER 25-NOVEMBER 23, 1980);
YEAR 1, CRUISE 4 = SPRING CRUISE (APRIL 22-MAY 5, 1981);
YEAR 2, CRUISE 2 = SUMMER CRUISE (JULY 16-AUGUST 5, 1981);
YEAR 2, CRUISE 3 = WINTER CRUISE (JANUARY 28-FEBRUARY 15, 1982).

Table 6-75. Dredge-collected taxa characteristic of particular station groupings from cluster analysis. Taxa listed are those exhibiting a high degree of constancy (occurring at most or all stations in the group) and fidelity (occurring only rarely at stations outside the group) for the stated groupings of stations.

I. Offshore Stations (Stations 10, 11, 23, 29, 30, 32, 35, 36, 38) - Depth Range 62 to 159m

Micropanope sculptipes (decapod)
Stylocidaris affinis (echinoid)
Discodermia sp. (sponge)

I.A. Deep Offshore Stations (Stations 32, 35, 36, 38) - Depth Range 127 to 159m

Siphonogorgia agassizii (alcyonacean)
Neocomatella pulchella (crinoid)
Ophiomusium sp. A (ophiuroid)

I.B. Mid-depth Offshore Stations (Stations 10, 11, 23, 29, 30) - Depth Range 62 to 77m

Peyssonnelia rubra (red alga)
Gonodactylus torus (stomatopod)
Ophioderma rubicundum (ophiuroid)
Poraniella regularis (asteroid)

I.B.I. Stations 23, 29, and 30 - Depth Range 60 to 76m

Anadyomene menziesii (green alga)
Palmellaceae n. sp. (green alga)

II. Inshore Stations (Stations 1, 3, 7, 9, 13, 15, 17, 19, 21) - Depth Range 20 to 58m

Cinachyra alloclada (sponge)
Celleporaria magnifica (bryozoan)
Nellia oculata (bryozoan)
Aequipecten muscosus (bivalve)
Laevicardium pictum (bivalve)
Paguristes sericeus (decapod)
Dromidia antillensis (decapod)
Clypeaster subdepressus (echinoid)

Table 6-75. Continued.

II.A. Shallow Inshore Stations (Stations 1, 7, 13, 15, 19) - Depth Range 20 to 32m

Laurencia intricata (red alga)
Udotea conglutinata (green alga)
Homaxinella waltonsmithi (sponge)
Solenastrea hyades (hard coral)
Siderastrea radians (hard coral)
Cladocora arbuscula (hard coral)
Macrocallista maculata (bivalve)
Gonodactylus bredini (stomatopod)
Mithrax (mithraculus) forceps (decapod)
Mithrax (mithrax) pleuracanthus (decapod)
Pilumnus sayi (decapod)

II.B. Mid-depth Inshore Stations (Stations 3, 9, 17, 21) - Depth Range 44 to 58m

Bracebridgia subsulcata (bryozoan)
Callidactylus asper (decapod)
Scyllarus chacei (decapod)
Genocidaris maculata (echinoid)

tered closely for each station (Figure 6-14). This is partly due to the qualitative (presence/absence) nature of the data, because striking seasonal variations in cover (particularly of algae) have been described for many stations in Section 6.3. Also, the groups that were most likely to exhibit strong seasonality in their occurrences, e.g., the algae, usually contributed a relatively small proportion of the total number of taxa included in the analysis, so their contribution was not heavily weighted. This subject is addressed further in Section 6.5.

6.4.3.2 Otter Trawl Data

A total of 1,148 taxa were collected from otter trawl samples on the four biological cruises; of these, 1,089 (95%) were identified to the genus or species level (a prerequisite for inclusion in cluster analyses). Most of the specimens that were not identified to genus or species were sponges. Twenty percent of all trawl-collected taxa were unique to the trawl samples (i.e., not collected in dredges), and fishes comprised the largest single contributor to this group. Of the total taxa identified to genus or species, 189 (17.4%) were crustaceans, 183 (16.8%) were sponges, 160 (14.7%) were fishes, 128 (11.8%) were molluscs, 106 (9.7%) were algae, 95 (8.7%) were cnidarians, and 91 (8.4%) were echinoderms. These groups accounted for 87.4% of all trawl-collected taxa. The most commonly captured representatives of each group are listed in Table 6-76. Tables 6-77 through 6-81 list the total number of taxa identified to genus or species collected from each station on each of the four cruises and for all cruises combined, broken down by major phyletic groups. The total number of taxa collected by trawl and identified to genus or species at each station (all cruises combined) varied from 308 (Station 9) to 75 (Station 35) (Figure 6-15). Most mid shelf stations had more taxa than the three shallowest stations (1, 13, and 19); generally, the outer shelf stations (32, 35, 36, and 38) and those in the southwest portion of the study area (Stations 23, 27, 29, and 30) had a low number of taxa. Similar trends are evident in the number of sponge, mollusc, and algal taxa (see Table 6-81).

Results of cluster analysis for the Fall Cruise (Figure 6-16) show two major groups of stations. The offshore group consisted of Stations 3, 9, 10, 11, 17,

Table 6-76. The most commonly captured taxa within each major group, from otter trawl data. The number of station/season occurrences of each taxon (out of a possible maxixum of 57) is given in parentheses. Only taxa identified to genus or species level are included.

SPONGES		CRUSTACEANS		ECHINODERMS	
Cinachyra alloclada	(28)	Stenorhynchus seticornis	(46)	Ophiothrix angulata	(40)
Geodia neptuni	(26)	Dromidia antillensis	(28)	Arbacia punctulata	(21)
Placospongia melobesioides	(25)	Portunus spinicarpus	(22)	Lytechinus variegatus carolinus	(20)
Ircinia strobilina	(22)	Mithrax (Mithrax) acuticornis	(18)	Echinaster sp.	(18)
Dysidea spp.	(18)	Mithrax (Mithrax) pleuracanthus	(18)	Ophiomyxa flaccida	(17)

MOLLUSCS		ALGAE		FISHES	
Vermicularia knorii	(13)	Halimeda gracilis	(21)	Monacanthus ciliatus	(40)
Aequipecten muscosus	(12)	Peyssonnelia rubra	(16)	Synodus intermedius	(33)
Laevicardium pictum	(12)	Lithothamnium calcareum	(16)	Serranus phoebe	(30)
Argopecten gibbus	(9)	Anadyomene menziesii	(15)	Syacium papillosum	(25)
Semirossia equalis	(9)	Caulerpa sertularioides	(12)	Synodus poeyi	(25)
				Hippocampus erectus	(22)
				Serranus notospilus	(21)
				Rypticus bistrispinus	(21)
				Halieutichthyes aculeatus	(19)
				Synodus foetens	(18)

BRYOZOANS		HYDROZOANS	
Steganoporella magnilabris	(30)	Thyroscyphus marginatus	(17)
Celleporaria albirostris	(26)	Aglaophemia elongata	(14)
Stylopoma spongites	(19)	Acryptolaria conferta	(9)
Amathia convoluta	(18)	Eudendrium carneum	(8)
C. magnifica	(15)	Sertularella pinnigera	(7)

Table 6-77. Fall Cruise, live bottom: Number of taxa identified to genus or species level captured by otter trawl. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	3	8	2	5	5	0	2	4	4	4
PHAEOPHYCOPHYTA	1	8	0	5	1	1	0	0	3	3
RHODOPHYCOPHYTA	9	7	3	5	3	5	2	1	3	3
PORIFERA	5	33	26	14	43	25	6	17	19	11
CNIDARIA	1	10	5	4	8	4	5	0	6	7
MOLLUSCA	0	8	1	18	15	4	5	6	14	10
ARTHROPODA-MANDIBULATA-CRUSTACEA	6	39	16	28	29	19	13	14	15	27
ECTOPROCTA	2	8	6	16	5	4	3	3	11	6
ECHINODERMATA	4	6	5	10	9	9	6	0	11	7
CHORDATA-UROCHORDATA	0	8	4	1	2	3	2	1	2	1
CHORDATA-GNATHOSTOMATA	14	29	13	34	20	10	13	12	23	26
ALL OTHERS	1	1	1	4	2	1	1	1	2	4
*TOTAL FALL CRUISE	46	165	82	144	142	85	58	59	113	109

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA		4	3	3	4				
PHAEOPHYCOPHYTA		0	1	0	0				
RHODOPHYCOPHYTA		5	3	3	3				
PORIFERA		20	5	18	20				
CNIDARIA		2	5	3	8				
MOLLUSCA		4	10	0	2				
ARTHROPODA-MANDIBULATA-CRUSTACEA		16	18	1	6				
ECTOPROCTA		1	4	2	2				
ECHINODERMATA		12	7	12	8				
CHORDATA-UROCHORDATA		0	1	0	0				
CHORDATA-GNATHOSTOMATA		24	21	10	23				
ALL OTHERS		1	1	0	0				
*TOTAL FALL CRUISE		89	79	52	76				

Table 6-78. Spring Cruise, live bottom: Number of taxa identified to genus or species level captured by otter trawl. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	3	1	3	1	2	2	0	2	0	2
PHAEOPHYCOPHYTA	2	0	2	1	0	2	2	1	0	2
RHODOPHYCOPHYTA	4	2	3	6	6	4	0	2	0	2
PORIFERA	3	12	16	10	14	21	12	31	27	7
CNIDARIA	5	10	5	7	10	12	10	10	5	1
MOLLUSCA	3	10	7	19	9	3	7	14	5	1
ARTHROPODA-MANDIBULATA-CRUSTACEA	9	35	13	44	36	19	33	24	16	9
ECTOPROCTA	6	7	3	15	11	4	5	6	12	0
ECHINODERMATA	9	10	4	9	9	7	6	6	9	8
CHORDATA-UROCHORDATA	10	2	3	3	2	1	4	5	6	0
CHORDATA-GNATHOSTOMATA	17	27	21	25	23	16	26	15	20	9
ALL OTHERS	2	0	0	3	1	1	1	1	2	0
*TOTAL SPRING CRUISE	73	116	80	143	123	92	106	117	102	41

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA	2	3	2	1	2				
PHAEOPHYCOPHYTA	1	1	1	0	0				
RHODOPHYCOPHYTA	3	5	2	2	0				
PORIFERA	18	27	3	11	21				
CNIDARIA	2	2	4	9	2				
MOLLUSCA	13	2	6	2	0				
ARTHROPODA-MANDIBULATA-CRUSTACEA	29	6	9	4	0				
ECTOPROCTA	7	1	4	1	0				
ECHINODERMATA	7	8	7	7	2				
CHORDATA-UROCHORDATA	7	2	2	4	0				
CHORDATA-GNATHOSTOMATA	27	13	19	20	2				
ALL OTHERS	0	1	2	1	1				
*TOTAL SPRING CRUISE	116	71	61	62	30				

Table 6-79. Summer Cruise, live bottom: Number of taxa identified to genus or species level captured by otter trawl. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	2	3	4	4		2	3	3		
PHAEOPHYCOPHYTA	3	3	6	2		2	3	2		
RHODOPHYCOPHYTA	6	2	7	6		4	2	3		
PORIFERA	2	14	21	10		16	2	17		
CNIDARIA	2	6	2	8		4	2	0		
MOLLUSCA	0	6	6	9		8	1	1		
ARTHROPODA-MANDIBULATA-CRUSTACEA	0	11	22	14		14	7	7		
ECTOPROCTA	1	8	3	16		2	2	0		
ECHINODERMATA	0	4	6	8		5	2	2		
CHORDATA-UROCHORDATA	2	5	9	3		3	0	0		
CHORDATA-GNATHOSTOMATA	0	14	25	23		20	6	11		
ALL OTHERS	2	0	2	2		2	1	0		
*TOTAL SUMMER CRUISE	20	76	113	105		82	31	46		

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA	3	6		2		0	0	2	0
PHAEOPHYCOPHYTA	1	3		0		1	1	1	1
RHODOPHYCOPHYTA	7	10		0		0	0	1	0
PORIFERA	25	12		15		10	7	6	7
CNIDARIA	0	1		11		2	15	10	10
MOLLUSCA	6	4		6		1	1	3	4
ARTHROPODA-MANDIBULATA-CRUSTACEA	10	9		6		3	4	21	19
ECTOPROCTA	2	3		1		1	1	0	0
ECHINODERMATA	4	10		12		3	14	12	15
CHORDATA-UROCHORDATA	5	1		3		0	1	1	1
CHORDATA-GNATHOSTOMATA	10	15		20		2	8	16	15
ALL OTHERS	0	0		0		0	1	0	0
*TOTAL SUMMER CRUISE	73	74		76		23	53	73	72

Table 6-80. Winter Cruise, live bottom: Number of taxa idnetified to genus or species level captured by otter trawl. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	4	1	1	3		0	2	2		
PHAEOPHYCOPHYTA	1	0	2	2		0	1	0		
RHODOPHYCOPHYTA	4	1	2	5		6	0	1		
PORIFERA	7	16	9	6		10	10	25		
CNIDARIA	1	0	0	6		2	6	2		
MOLLUSCA	7	9	7	12		7	3	8		
ARTHROPODA-MANDIBULATA-CRUSTACEA	5	10	6	30		19	17	13		
ECTOPROCTA	1	4	3	6		3	2	3		
ECHINODERMATA	6	5	5	13		6	6	2		
CHORDATA-UROCHORDATA	4	3	5	4		3	1	0		
CHORDATA-GNATHOSTOMATA	8	14	4	39		22	15	10		
ALL OTHERS	0	0	0	1		0	0	0		
*TOTAL WINTER CRUISE	48	63	44	127		78	63	66		

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA	1	2		1		1	0	2	0
PHAEOPHYCOPHYTA	1	1		0		0	0	0	0
RHODOPHYCOPHYTA	1	2		3		1	1	0	0
PORIFERA	18	17		20		12	2	3	2
CNIDARIA	1	4		13		4	11	7	11
MOLLUSCA	4	3		4		1	1	3	5
ARTHROPODA-MANDIBULATA-CRUSTACEA	15	6		4		21	4	18	13
ECTOPROCTA	3	2		2		1	1	0	2
ECHINODERMATA	3	8		9		7	7	13	15
CHORDATA-UROCHORDATA	2	1		4		0	0	1	0
CHORDATA-GNATHOSTOMATA	29	11		22		28	12	17	12
ALL OTHERS	0	0		0		1	0	0	0
*TOTAL WINTER CRUISE	78	57		82		77	39	64	60

Table 6-81. All Cruises combined: Number of taxa identified to genus or species level captured by otter trawl.

TAXONOMIC GROUP	STATION 01	03	07	09	10	11	13	15	17	19
CHLOROPHYCOPHYTA	9	9	6	8	6	4	7	7	4	5
PHAEOPHYCOPHYTA	7	10	10	9	1	4	5	3	3	5
RHODOPHYCOPHYTA	18	10	10	18	7	11	4	7	3	4
PORIFERA	12	54	48	30	50	47	21	50	41	15
CNIDARIA	7	23	10	14	16	15	15	11	10	8
MOLLUSCA	9	26	17	39	23	17	12	25	16	11
ARTHROPODA-MANDIBULATA-CRUSTACEA	15	59	41	65	51	40	38	38	26	30
ECTOPROCTA	8	14	11	28	14	8	9	7	19	6
ECHINODERMATA	10	15	11	20	13	15	14	7	16	12
CHORDATA-UROCHORDATA	12	13	13	7	3	6	6	5	7	1
CHORDATA-GNATHOSTOMATA	25	56	44	64	31	42	41	32	33	29
ALL OTHERS	4	1	2	6	3	3	2	2	4	4
TOTAL	136	290	223	308	218	212	174	194	182	130

TAXONOMIC GROUP	21	23	27	29	30	32	35	36	38
CHLOROPHYCOPHYTA	4	7	3	4	4	1	0	3	0
PHAEOPHYCOPHYTA	3	5	2	0	0	1	1	1	1
RHODOPHYCOPHYTA	9	16	5	6	3	1	1	1	0
PORIFERA	42	53	7	41	32	19	7	9	9
CNIDARIA	2	6	6	27	10	5	18	14	17
MOLLUSCA	21	11	16	10	2	2	2	4	9
ARTHROPODA-MANDIBULATA-CRUSTACEA	37	24	23	12	6	23	7	30	26
ECTOPROCTA	8	4	7	3	2	2	2	0	2
ECHINODERMATA	10	23	12	22	9	8	17	17	22
CHORDATA-UROCHORDATA	11	3	2	7	0	0	1	2	1
CHORDATA-GNATHOSTOMATA	46	42	31	38	24	28	18	25	22
ALL OTHERS	0	2	2	1	1	1	1	0	0
TOTAL	193	196	116	171	93	91	75	106	109

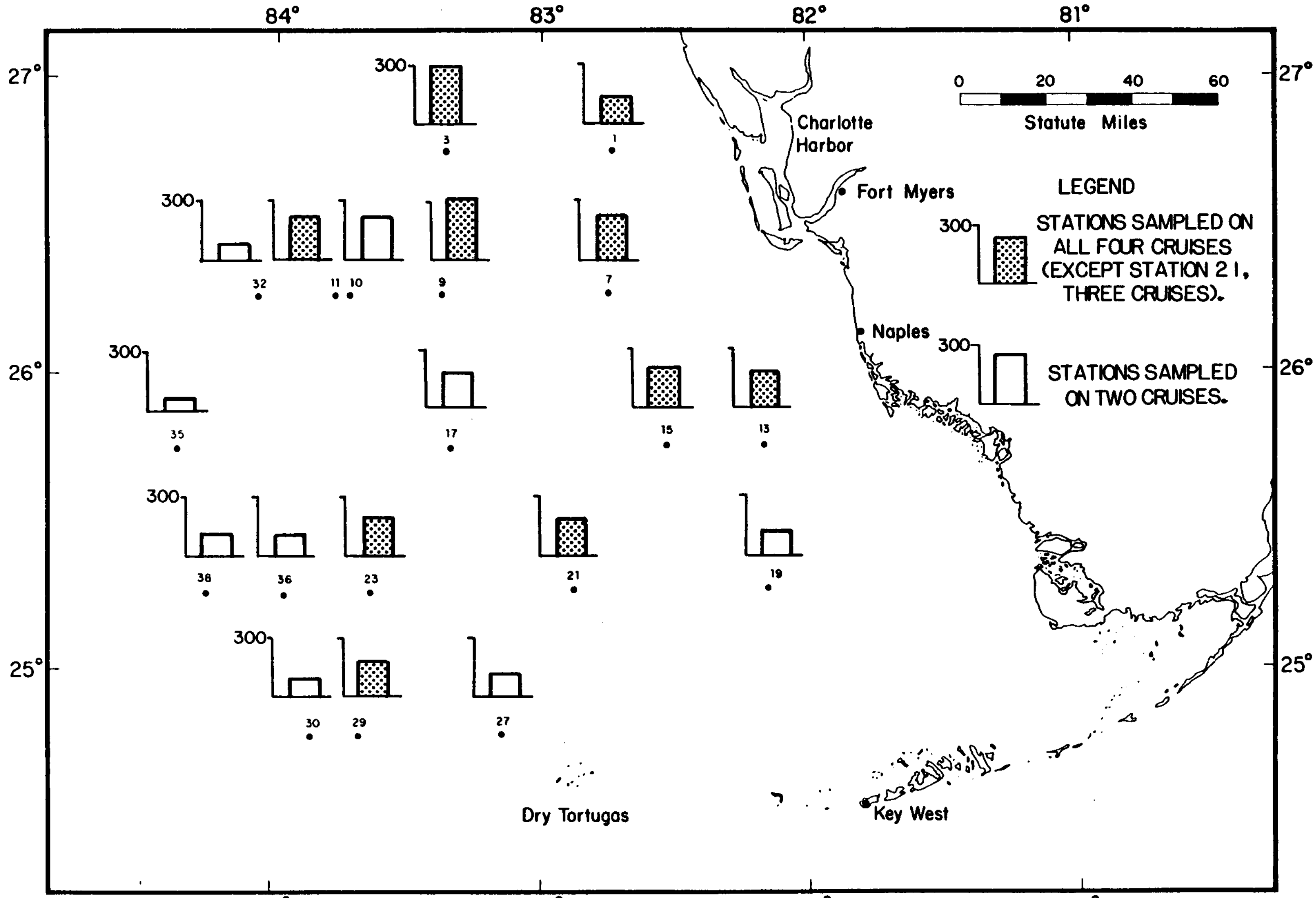


Figure 6-15. Shelfwide variation in the number of taxa (identified to genus or species) collected by otter trawl sampling at live bottom stations.

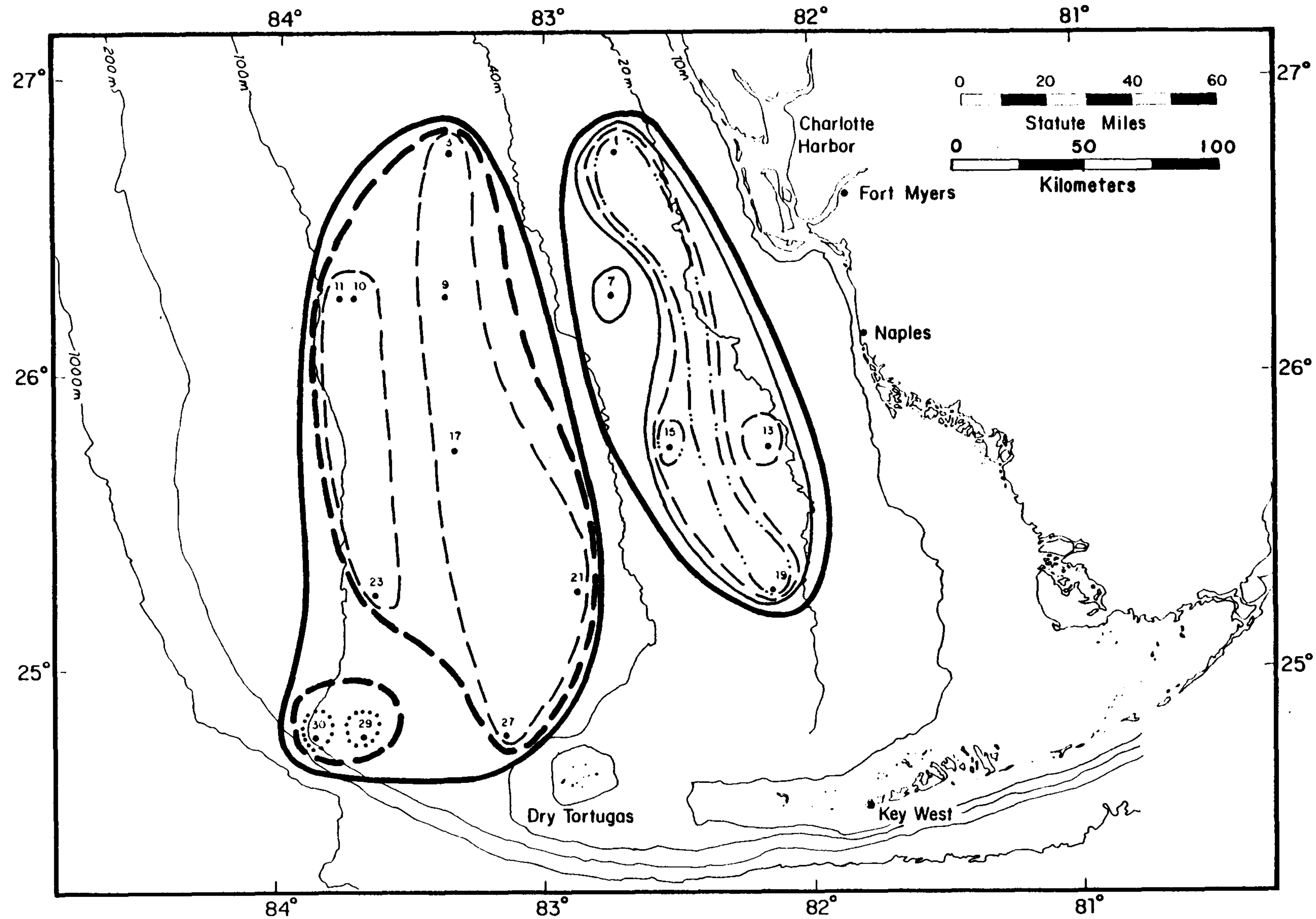


Figure 6-16. Station groupings from cluster analysis of live bottom otter trawl data, Fall Cruise.

21, 23, 27, 29, and 30, in 44 to 77m depth. Thirty-six species were unique or nearly unique to the offshore group. Characteristic species included the crustose red alga Peyssonnelia rubra, the sponge Bubaris spp., the ophiuroids Ophiothrix angulata and Ophiomyxa flaccida, and the marbled puffer Sphoeroides dorsalis. Stations 29 and 30 formed a subcluster that reflects faunal affinities with inshore stations. The inshore group consisted of Stations 1, 7, 13, 15, and 19 (20 to 32m depth). Unique species included the crustacean Pilumnus sayi and the sand perch Diplectrum formosum; additional characteristic species included the seagrass Halophila decipiens, the penaeid crustacean Metapenaeopsis goodei, and the bryozoan Cupuladria biporosa. Station 7 was somewhat dissimilar to other inshore stations in the presence of several taxa that were more characteristic of the offshore stations.

The typical offshore-inshore pattern was broken for the Spring Cruise otter trawl data (Figure 6-17). One group contained Stations 3, 9, 10, 11, and 27 (depth range: 50 to 77m), which were uniquely characterized by the occurrence of the decapods Munida pusilla, Podochela lamelligera, Stenocionops furcata furcata, and Hypoconcha spinossima, the stomatopod Meiosquilla quadridens, and the cephalopod Semirossia equalis. Station 27 lacked several species common to the group and had several species in common with the other major group. The second large grouping contained most of the inshore stations (Stations 1, 7, 13, 15, 17, 19, and 21) and the three offshore stations (Stations 23, 30, and 29) in the southwestern portion of the study area. The consistent occurrence of the sea urchin Arbacia punctulata was characteristic of this group of stations. Stations 21, 23, 29, and 30 (depth range: 44 to 76m) formed a subcluster with no unique species but characteristically having the alga Anadyomene menziesii and the sponge Jaspis spp. The other subcluster, consisting of Stations 1, 7, 13, 15, 17, and 19 (depth range: 20 to 58m) had two unique species: the bluespotted sea robin Prionotus roseus and the holothuroid Isostichopus badionotus. In addition, the stomatopod Gonodactylus bredini and the decapod Mithrax (Mithrax) pleuracanthus were characteristic of this group of stations.

During the Summer Cruise (Figure 6-18), major offshore and inshore groups were again evident. The offshore stations (Stations 32, 35, 36, and 38) occurred in

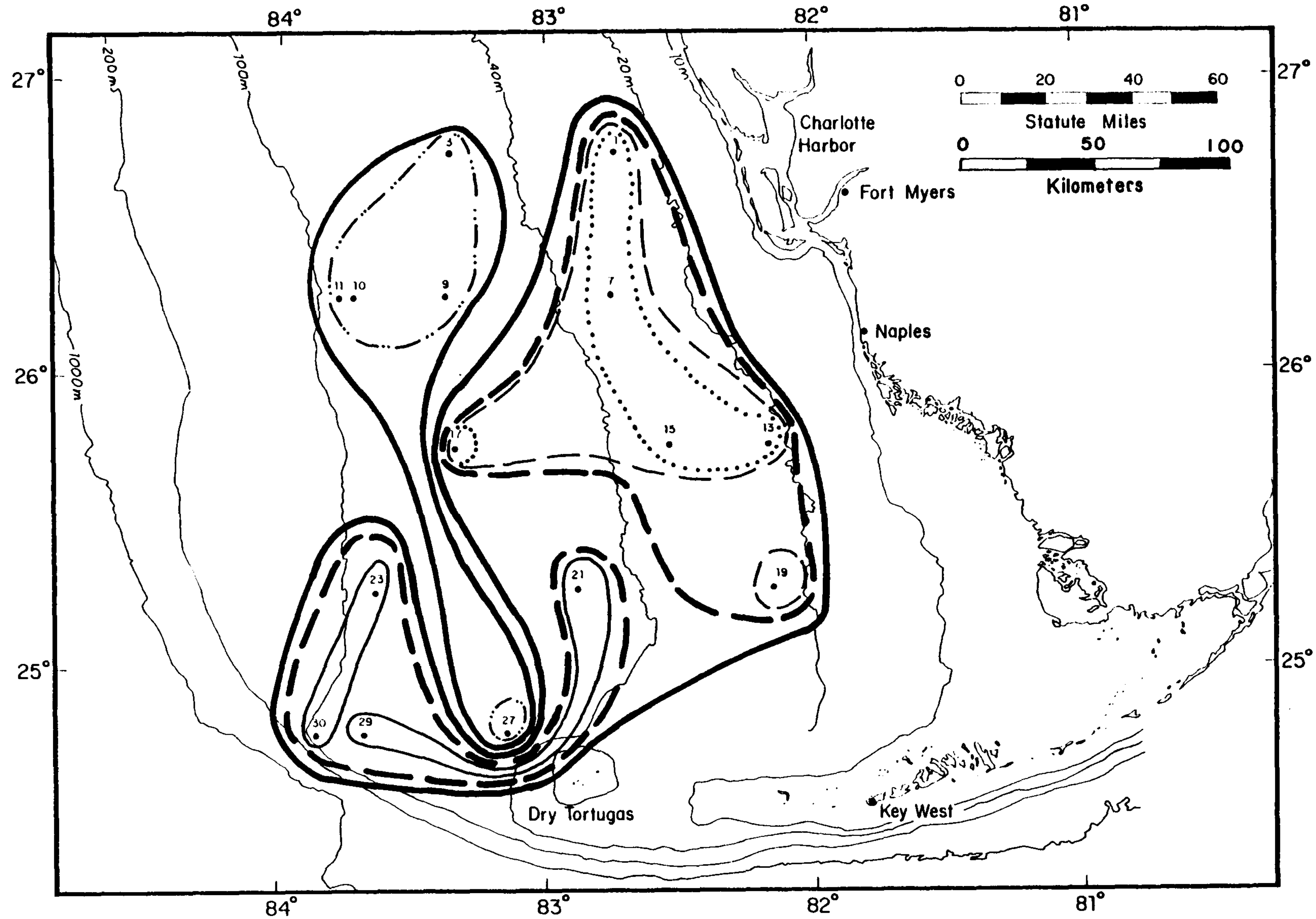


Figure 6-17. Station groupings from cluster analysis of live bottom otter trawl data, Spring Cruise.

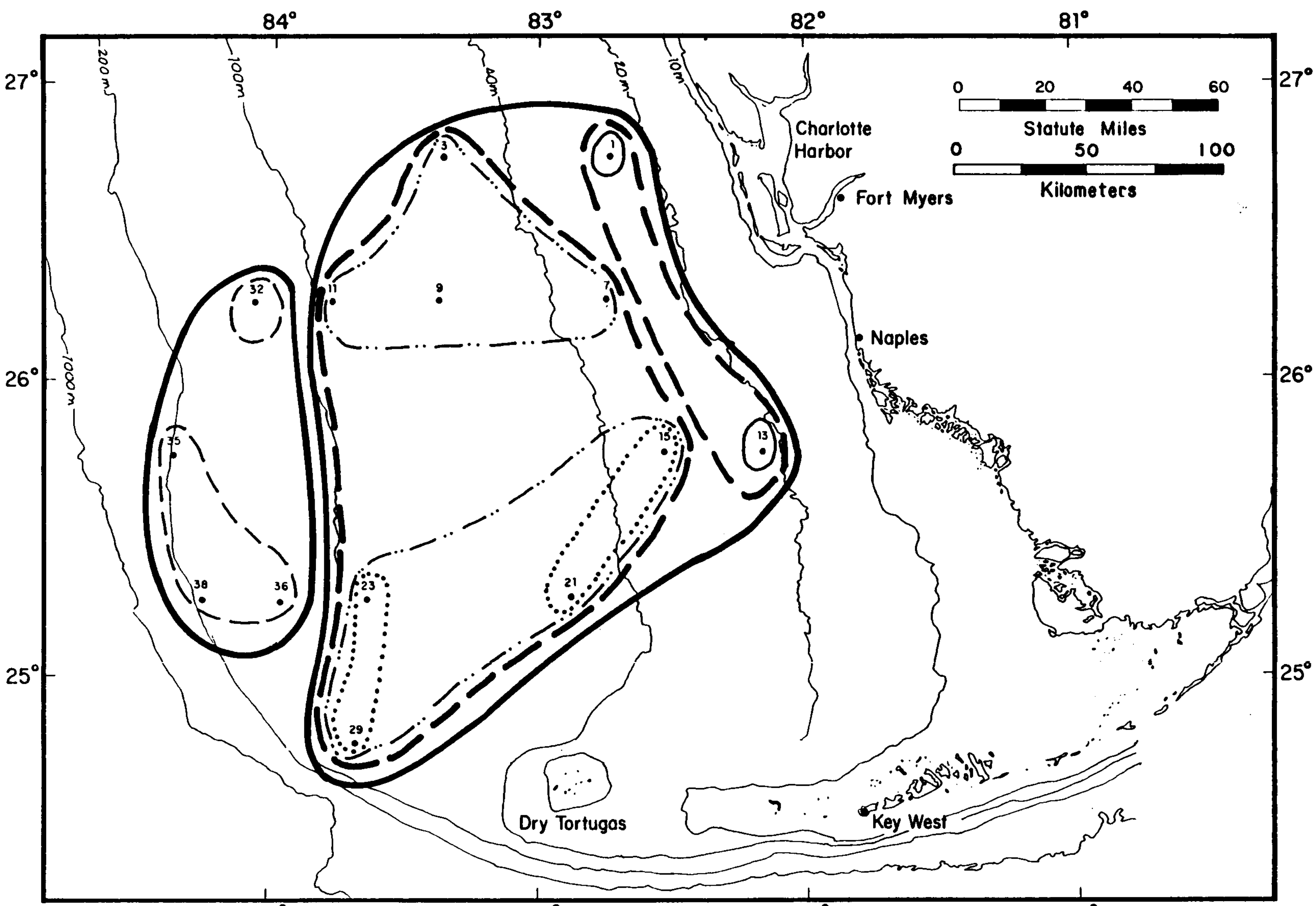


Figure 6-18. Station groupings from cluster analysis of live bottom otter trawl data, Summer Cruise.

127 to 159m depth; unique species included the crinoids Leptonemaster venustus, Comactinia meridionalis, and Neocomatella pulchella, and the alcyonacean Siphonogorgia agassizii. The inshore group (Stations 1, 3, 7, 9, 11, 13, 15, 21, 23, and 29) consisted of stations in 20 to 77m depth; about 50 species were unique to the cluster. Stations 1 and 13, the shallowest stations at 24 and 20m, respectively, formed a subcluster having no unique species but lacking several others commonly encountered at other inshore stations. The outer subcluster in the inshore group consisted of eight stations ranging in depth from 30 to 77m and having about 40 unique species. The yellowtail reeffish Chromis enchrysurus, the sand diver Synodus intermedius, the fringed filefish Monacanthus ciliatus, and the brittle star Ophiothrix angulata were characteristic of this group of stations. A north-south subcluster was also evident, with the northern group (Stations 3, 9, 7, and 11) uniquely having the asteroid Echinaster sp. A, the crustacean Munida angulata, and the smoothhead scorpionfish Scorpaena calcarata; the southern group (Stations 15, 21, 23, and 29) had no unique species.

During the Winter Cruise, the same major offshore-inshore groupings were noted (Figure 6-19). The offshore stations had several unique species, including the decapods Nibilia antilocapra and Homola barbata, the crinoids Neocomatella pulchella and Comactinia meridionalis, the fishes Antigonia capros (deepbody boarfish) and Pontinus rathbuni (highfin scorpionfish), the sponge Sigmadocia spp., and the alcyonacean Siphonogorgia agassizii. The inshore group, consisting of the remaining 10 stations (depth range 20 to 77m), was characterized by about 40 species unique to the cluster. The most characteristic of the group as a whole were the sponge Placospongia melobesioides, the bryozoan Celleporaria albirostris, and the fringed filefish Monacanthus ciliatus. Stations 1, 7, 13, 15, and 29 (depth range 20 to 62m) had no unique species. The outer subgroup (Stations 3, 9, 11, 21, and 23; depth range 44 to 77m) had several unique and/or characteristic species. These included the red seaweed Gracilaria mammillaris, the penaeid crustacean Metapenaeopsis goodei, the gastropod Vermicularia spirata, the fish Porichthys plectrodon (Atlantic midshipman), the ascidian Didemnum candidum, and the bryozoan Steganoporella magnilabris.

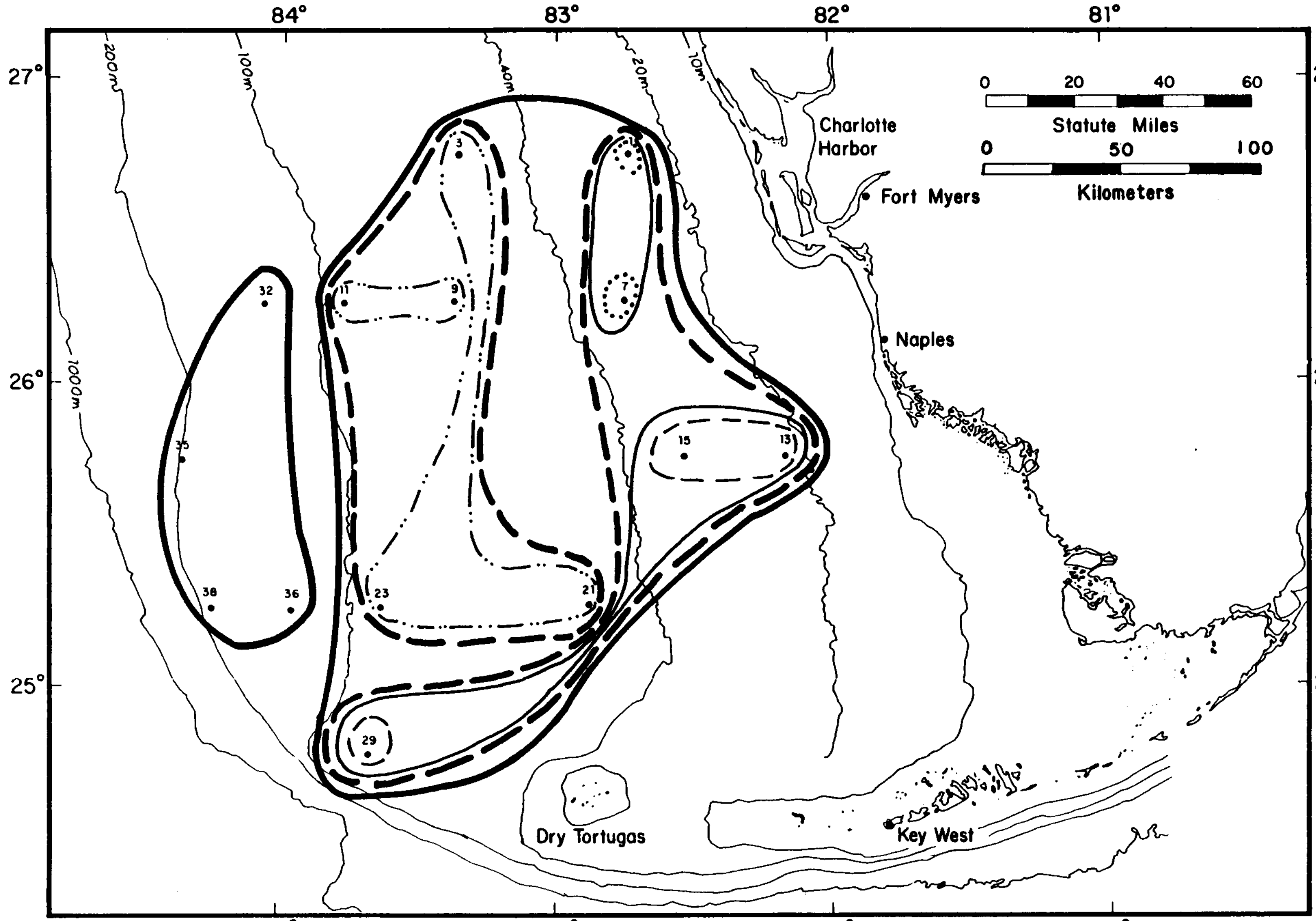


Figure 6-19. Station groupings from cluster analysis of live bottom otter trawl data, Winter Cruise.

When data from all cruises were included (Figure 6-20), the results illustrate the general grouping into offshore and inshore stations; because of apparent seasonal differences at some stations, major clusters overlapped (at Station 11, for example) and several stations fell into more than one minor cluster (for example, Stations 1 and 13 grouped separately for the Summer Cruise results but not for other cruises). The offshore group consisted of Stations 11, 23, 29, 30, 32, 35, 36, and 38, ranging in depth from 62 to 159m. No species were unique to or particularly characteristic of this group. The southern subcluster, consisting of Stations 23, 29, and 30, was characterized by the consistent occurrence of the green alga Anadyomene menziesii and the sponges Geodia neptuni and Jaspis sp. (although these were not unique to the cluster). The inshore group consisted of the remaining 12 stations at depths ranging from 20 to 77m. Fourteen species were unique to the cluster. The most characteristic species were the ascidian Didemnum candidum, the sponge Cinachyra alloclada, the dusky flounder Syacium papillosum, and the decapod Dromidia antillensis. An inner subcluster of stations (1, 3, 7, 13, 15, 17, 19, and 21) was characterized by the presence of the crustaceans Mithrax (Mithrax) pleuracanthus and Gonodactylus bredini. An outer subcluster of stations (3, 9, 10, 11, 17, and 27) was characterized by several species including the crustaceans Munida pusilla, Stenocionops furcata furcata, and Scyllarus chacei, the green alga Halimeda gracilis, the bryozoan Idmidronea atlantica, and the blackedge moray Gymnothorax nigromarginatus.

Figure 6-21 shows the station dendrogram for the "all cruises combined" analysis, and Table 6-82 is the corresponding two-way table for taxa and stations included in the analysis.

Table 6-83 summarizes taxa characteristic of particular station groupings emerging from these cluster analyses.

Summary -- Results of the otter trawl clustering, in general agreement with the pattern produced from the triangle dredge data, showed general offshore and inshore groups relatable to depth on the shelf. Inshore stations were generally those in depths ranging from 20 to 77m; offshore stations were those in 62 to 159m depth. Comparison of results among the four seasonal cruises indicates

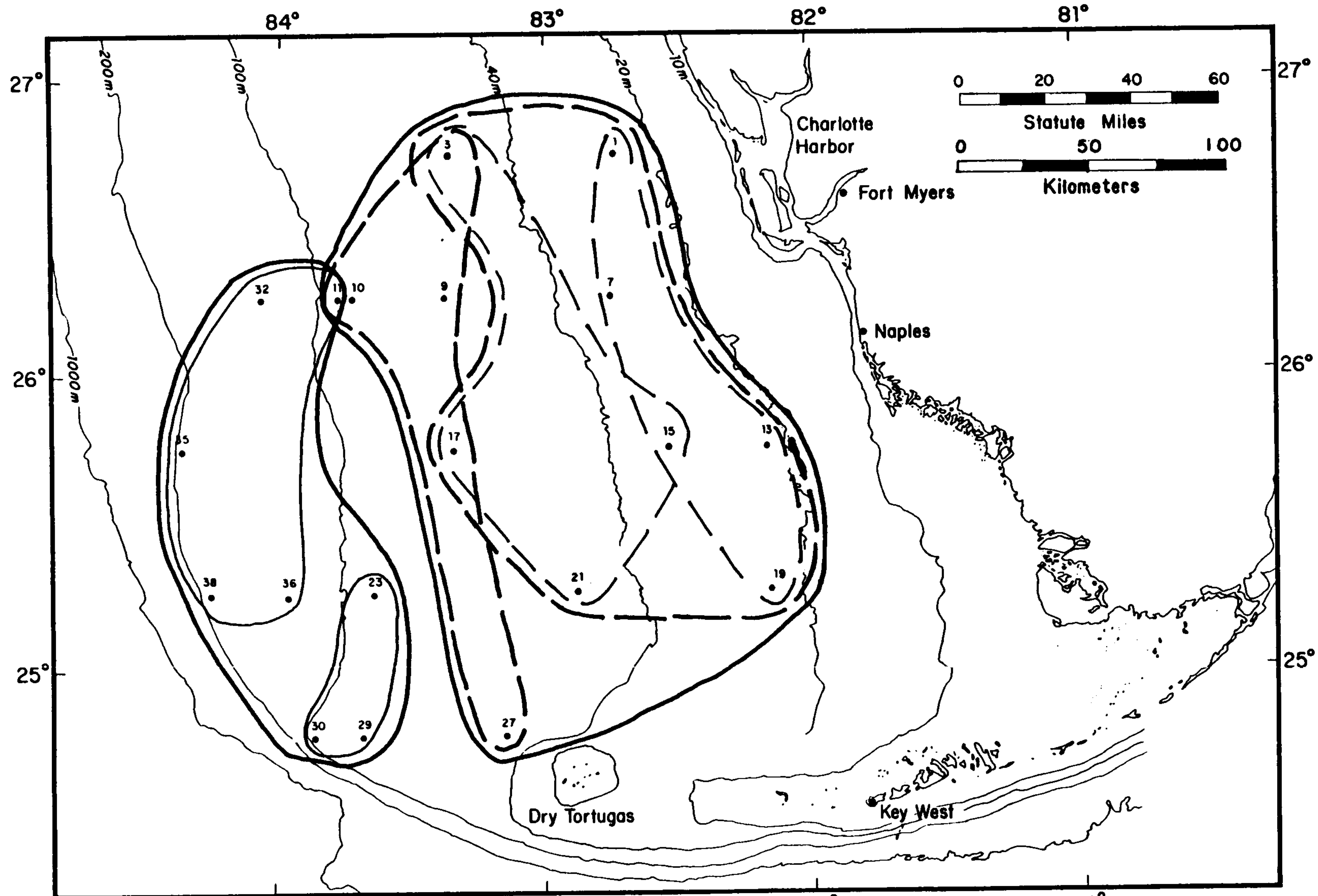
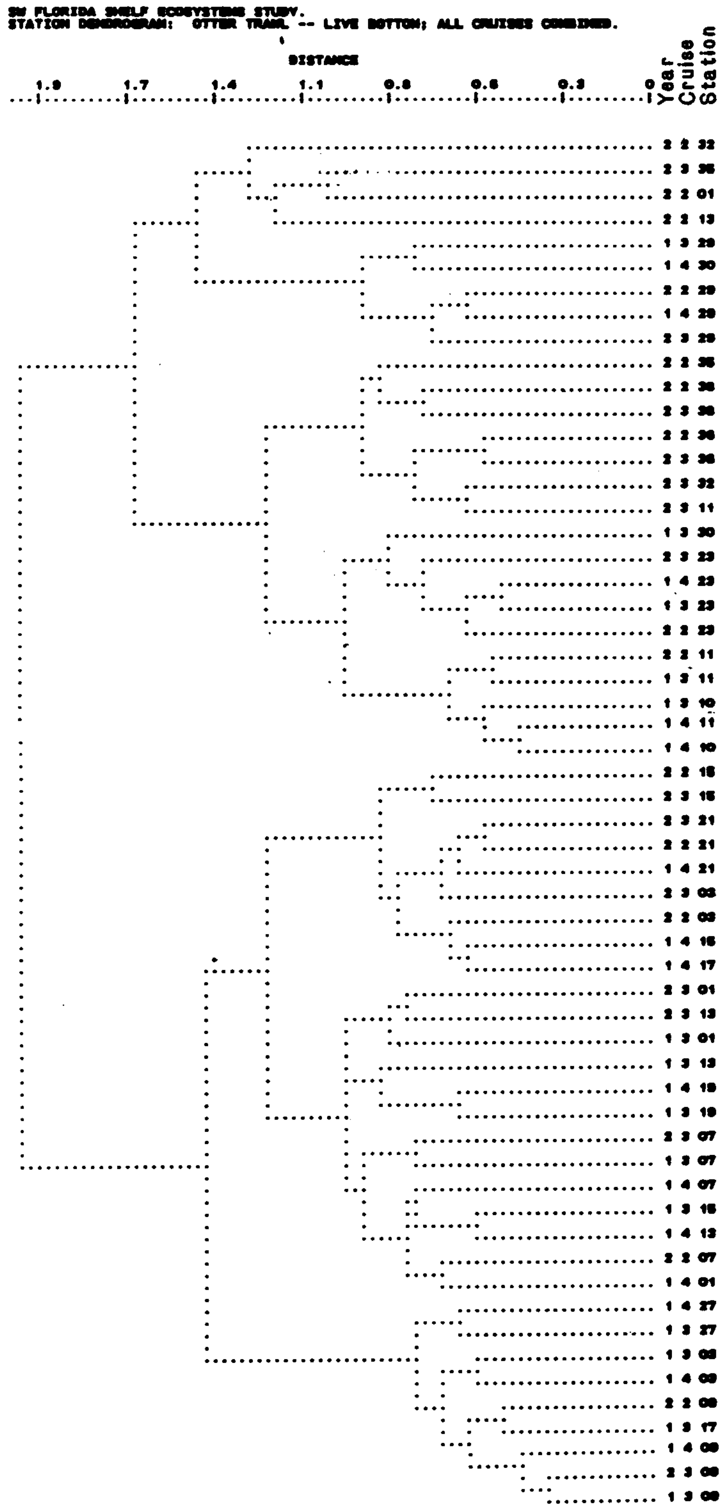


Figure 6-20. Simplified station groupings from cluster analysis of live bottom otter trawl data, all cruises combined.



NOTE: YEAR 1, CRUISE 3 = FALL CRUISE (OCTOBER 25-NOVEMBER 23, 1980); YEAR 1, CRUISE 4 = SPRING CRUISE (APRIL 22-MAY 5, 1981); YEAR 2, CRUISE 2 = SUMMER CRUISE (JULY 16-AUGUST 5, 1981); YEAR 2, CRUISE 3 = WINTER CRUISE (JANUARY 28-FEBRUARY 15, 1982).

Figure 6-21. Station dendrogram from cluster analysis of otter trawl data from live bottom stations, all cruises.

Table 6-82. Two-way table of station/season occurrences of taxa at live bottom stations based on otter trawl sample data included in the "all cruises" cluster analysis.

```
YEAR                           2 2 1 1 2 2 2 2 2 1 2 1 1 2 2 2 1 2 1 1 2 1 1 1 1 1 1 2
CRUISE                         3 2 4 4 2 3 3 3 3 3 2 3 4 3 2 3 4 3 3 4 3 4 4 4 3 4 3 3
STATION                        3 1 3 2 3 3 3 1 2 2 1 1 1 1 2 0 1 0 0 1 0 0 1 0 2 0 1 0
                               5 3 0 9 5 8 6 1 3 3 1 0 0 5 1 3 5 1 1 9 7 7 3 1 7 3 7 9
YEAR                          2 2 1 2 2 2 2 2 1 1 2 1 1 2 2 1 2 1 2 1 1 1 1 2 1 1 2 1 1
CRUISE                        2 2 3 2 3 2 2 3 3 4 2 3 4 2 3 4 2 4 3 3 3 3 3 2 4 3 2 4 3
STATION                       3 0 2 2 2 3 3 3 3 2 2 1 1 1 2 2 0 1 1 1 1 0 1 0 2 0 0 0 0
                              2 1 9 9 9 8 6 2 0 3 3 1 1 5 1 1 3 7 3 3 9 7 5 7 7 3 9 9 9
                              1234567890123456789012345678901234567890123456789012345678901234567
TAXON

PONTINUS RATHBUNI             --        -- --    -   --                           -
SARGASSUM FLUITANS            -        -- -     - -      -   -       -      -    -  -
? DYSIDEA SPP.                -     -       -- -        -     - -- -          -     -
? BUBARIS SPP.                -   -    -  -   ----- ----                         -  -
? BIEMNA SPP.                     --   -  - - ------ --    -             -             -
SCYLLARUS DEPRESSUS                 - -   ----- -- -- --
STYLOCIDARIS AFFINIS           -       - -----  ---- ---        -                    -
MESOPENAEUS TROPICALIS                  ------     -  --  -                         -
PROCESSA TENUIPES                       -- ----  - -   -                         -  -
PRISTIGENYS ALTA               -  -    -    - -   -            -         -  -      - -
SAURIDA BRASILIENSIS           -      -- -          -           -         -    -    -  -
HYATTELLA INTESTINALIS            --           --- -     - -   --                    -
? HALICHONDRIA SPP.                -    -       -    -          -  -    - -         - -
MICROCIONA SPP.                        -  -        --- - - -            - -  -          -
ANADYOMENE MENZIESII              -----   --  - ---          -        --          -
GEODIA NEPTUNI                    ----- -  - ---- ----------   -- - --
? JASPIS SPP.                      ----        -------    --  -  -         -        -
CHROMIS ENCHRYSURUS                 ---         ---  -  - --  -                   -
EUDISTOMA CAPSULATUM                ---   -  -  - --       -    -      -    -   - -
SCORPAENA DISPAR                    -- -      - ---  ---  - -
APOGON PSEUDOMACULATUS              ---       -     -   -  - -                     -  -
ADIORYX BULLISI                     ---      --  -   - -  --                   - - -
PARTHENOPE FRATERCULUS                  -    - --- -----                            -
PEYSSONNELIA RUBRA                -  -       ------ ----                         -  -- -
OPHIOMYXA FLACCIDA                - --          -------         -              -  -----
MADRACIS ASPERULA                  -     -     --- -----                       -  -----
PODOCHELA LAMELLIGERA                  -- ---- -   -----                    -    -- - -
SERRANUS NOTOSPILUS                    --- ---  -- -----      - -          --    ----
SCORPAENA AGASSIZI                          --   -   ---          -             -     ---
CLADOCORA ARBUSCULA             -                        -     -  --  - --  --  -
RHABDOPLEURA COMPACTA           -                              -        -  ----    --- -
AMATHIA CONVOLUTA              --            --      -  -- -    --  -      --        -----
CINACHYRA ALLOCLADA             -  -          -  -  ---- -    ------   -------  - -----
THALASSIA TESTUDINUM            -                -  --                -     - --  - --  -
HALICLONA COMPRESSA              -  -         --           -    -  --  ---    -
ANTHOSIGMELLA VARIANS            -            -         --  -- -    ---   --        -
OPHIOTHRIX SUENSONII             -- -                    ---- -         -  -
NIPHATES ERECTA                       --      -         ----- --- -       --    -
SPHECIOSPONGIA VESPARIUM                            -     - ------- -
AIOLOCHROIA CRASSA                                   -    -------- -       --       -
MITHRAX (MITHRAX) PLEURACAN      -                   -  --  -  -- -----  ----- -
GONODACTYLUS BREDINI                                      -  - --  ---  -  ------
LACTOPHRYS QUADRICORNIS          -  -                 -     - -    --- -- -- -    -     -
EPINEPHELUS MORIO                                         ----- -  -   -  - -          -
AEQUIPECTEN MUSCOSUS                                          -  - --   --   ----    --
DIPLECTRUM FORMOSUM                                           --  -------  -----   --
LAEVICARDIUM PICTUM                                           --   -- - -  - --   --  -
SYNODUS FOETENS                                      -    --  - -------- --   --   --
MITHRAX (MITHRAX) ACUTICORN         --         ------    ------                   --   -
IRCINIA STROBILINA                 -- -   -    --   --- ------    -       -    -- -
PLACOSPONGIA MELOBESIOIDES            -        --   --- --------- -  -----  -   --
CYSTODICTYON PAVONIUM                               -  -    -----  --  -          -
? LEUCOSOLENIA SPP.                 - -            --       - -     -           --  - -
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Table 6-82 (Continued)

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MONACANTHUS CILIATUS          -   -----        ------------  -   - ------ ---  -  -------- ------
STENORHYNCHUS SETICORNIS            - ----------- --------------------  - -----  ------  ---------
DIDEMNUM CANDIDUM              -    --   -     - -    ------  --------       --------------------
SERRANUS PHOEBE                           - -----------------  ------  -      -        ---   -----
SYNODUS INTERMEDIUS                        -   --  -------  - --  -------  -  -  -----  ---  ------
STEGANOPORELLA MAGNILABRIS                     -------------  --------    -   --        ---------
ARBACIA PUNCTULATA                -----              -          -------   -   ---  - -  - ---
CELLEPORARIA ALBIROSTRIS          - ---          -           --  ------      -------- --- -----
LYTECHINUS VARIEGATUS CAROL         -             ---       -   -   -  - --   --    ----- -  - --
NEOFIBULARIA NOLITANGERE                         -   -    --------  --                -     -
SPIRASTRELLA COCCINEA             - -                   -    -  -  ---       -        ---   -
THYROSCYPHUS MARGINATUS           -   -                        -  - ---  -    -     -  ---  -----
CODIUM ISTHMOCLADUM              -                      -   --  -                 -     --  -   -
OPHIOTHRIX ANGULATA           -   -      -- ---  ------------- ---  ---        -  --------------
RYPTICUS BISTRISPINUS              -       --     --     -----   -   -         -----    - --  ---
AGLAOPHENIA ELONGATA              - -         -        -  --          -        -      -   --  ---
VERMICULARIA KNORII                   -         -     ---    -    -  -          -         --  --
APOGON MACULATUS                      -        -  --          ---                   -   - - --  -
METAPENAEOPSIS GOODEI            -   -         -           -  ---        -   -  -----     -   ---
SYACIUM PAPILLOSUM               -           - -           -- -  ------     --    ------- -------
NELLIA OCULATA                   -                                   --   -  -    ---    - -  - -
MONACANTHUS HISPIDUS                              -     -      -            -        ---   -  -  --
HIPPOCAMPUS ERECTUS                                  -  -------      -   ----- - ---  - -  -   -  --
OPHIOLEPIS ELEGANS                                       - -           ---  ------  --  -   -----
LITHOTHAMNIUM CALCAREUM                          - --       --         -   -  -----        ---  - -
PHIMOCHIRUS HOLTHUISI                            -         - - -     -  -      ---   -       ---
CELLEPORARIA MAGNIFICA           -                     --  -       -   ---           -   ------ -
TRACHINOCEPHALUS MYOPS                       -          -  -            - - -    -    -    ---  ---
TOZEUMA SERRATUM                             -               -         -  --         ---  ----- - -
SYNALPHEUS TOWNSENDI                            -          -   -   -    - - -              -- -----
SARGASSUM SP.                                            -  -      -   -      -   -  - -  --      -
SCORPAENA BRASILIENSIS                                        - --     -      --     ----- -- -----
PRIONOTUS ROSEUS                                                -      --        --  ---  -- --  --
PILUMNUS FLORIDANUS                                            -  --   --                  ---   --
HALIEUTICHTHYS ACULEATUS                 -  -----    -    ---      -   -               ------  ---
SYNODUS POEYI                                ----- - - -----      -----      -  -   - ----- -----
MUNIDA PUSILLA                            - --         ------ -     -                     ------ -
GYMNOTHORAX NIGROMARGINATUS                    -       -------             -      -   - -  - ------
STEPHANOSCYPHUS CORNIFORMIS           -                -----                    -     ----    -
SPHOEROIDES DORSALIS                              -  --    -         -            -     --  ----- -
IDMIDRONEA ATLANTICA                              -         --     - -            -     -  ------ -
EUCIDARIS TRIBULOIDES TRIBU            -           -       -      -                     -  ------
GENOCIDARIS MACULATA                      -         -             -    -                 --------
CENTROPRISTIS OCYURUS                            -           --     -   -             -     ---  --
SCYLLARUS CHACEI                                           - -                        - ------   --
SPHOEROIDES SPENGLERI                            -         - -     -        -  - -    - -  --
ECHINASTER SP.                                   --      ---         -     -----       --  --   ---
BOTHUS ROBINSI                                              -      -       --  -  -  -    ---------
DROMIDIA ANTILLENSIS                                  - -   ---  --- ---   -   --   --- ------------
STYLOPOMA SPONGITES                                     -  --     -  ----       -  -       ---------
CAULERPA SERTULARIOIDES                               - -   -                 - -  -        - --  --
PORTUNUS SPINICARPUS                          --  -   -  -------      --          -   -  -----  ---
HALIMEDA GRACILIS                                    - --   ---        -   -    -  --  -  ----  ----
STENOCIONOPS FURCATA FURCAT                             -  - --                    - - -  - ----- -
DYSIDEA SPP.                                      -  -   -------      - -           - -    ------
SICYONIA BREVIROSTRIS                             -   -    -       -  -                  ----   ---
GALATHEA ROSTRATA                                       -   -          - -                 ---------
                              1234567890123456789012345678901234567890123456789012345678901234567
```

SYMBOL DEFINITIONS: ( ) = ABSENT ; (-) = PRESENT

NOTE: YEAR 1, CRUISE 3 = FALL CRUISE (OCTOBER 25-NOVEMBER 23, 1980);
YEAR 1, CRUISE 4 = SPRING CRUISE (APRIL 22-MAY 5, 1981);
YEAR 2, CRUISE 2 = SUMMER CRUISE (JULY 16-AUGUST 5, 1981);
YEAR 2, CRUISE 3 = WINTER CRUISE (JANUARY 28-FEBRUARY 15, 1982).

Table 6-83. Trawl-collected taxa characteristic of particular station groupings from cluster analysis. Taxa listed are those exhibiting a high degree of constancy (occurring at most or all stations in the group) and fidelity (occurring only rarely at stations outside the group) for the stated groupings of stations.

I. Offshore Stations (Stations 11, 23, 27, 30, 32, 35, 36, 38) - Depth Range 62 to 159m

None characteristic of the group as a whole

I.A. Deep Offshore Stations (Stations 32, 35, 36, 38) - Depth Range 127 to 159m

Neocomatella pulchella (crinoid)
Comactinia maridionalis (crinoid)
Leptonemaster venustus (crinoid)
Siphonogorgia agassizii (alcyonacean)
Homola barbata (decapod)
Nibilia antilocapra (decapod)
Sigmadocia spp. (sponge)
Pontinus rathbuni (highfin scorpionfish)
Antigonia capros (deepbody boarfish)

II. Inshore Stations (Stations 1, 3, 7, 9, 10, 13, 15, 17, 19, 21, 27) - Depth Range 20 to 77m

Didemnum candidum (ascidian)
Cinachyra alloclada (sponge)
Dromidia antillensis (decapod)
Syacium papillosum (dusky flounder)
Celleporaria albirostris (bryozoan)

II.A. Shallow Inshore Stations (Stations 1, 7, 13, 15, 19) - Depth Range 20 to 32m

Gonodactylus bredini (stomatopod)
Mithrax (Mithrax) pleuracanthus (decapod)
Pilumnus sayi (decapod)
Synodus foetens (inshore lizardfish)
Diplectrum formosum (sand perch)

Table 6-83. Continued.

II.B. Mid-depth Inshore Stations (Stations 3, 9, 10, 11, 17, 27) - Depth Range 50 to 77m
Halimeda gracilis (green alga)
Stephanoscyphus corniformis (hydrozoan)
Idmidronea atlantica (bryozoan)
Munida pusilla (decapod)
Stenocionops furcata furcata (decapod)
Scyllarus chacei (decapod)
Gymnothorax nigromarginatus (blackedge moray)

some variability in these patterns (especially the Spring Cruise, for example), but again, most seasonal samplings for each station clustered fairly closely (Figure 6-21). Stations 3, 11, 15, 17, and 32 had the highest "seasonal" differences in taxonomic composition, whereas Stations 9, 10, 19, 21, and 27 had the lowest. This problem is addressed in detail in Section 6.5.

6.4.3.3 Summary of Cluster Analysis Results

Results of both triangle dredge and otter trawl data indicate a consistent pattern in the distribution of taxa across the shelf, primarily related to depth. The pattern, illustrated in Figure 6-22, consists of a large group of shallow (20 to 40m) and mid-depth (40 to 60m) inner shelf stations and a second major group of mid-depth (60 to 80m) and deep (130 to 160m) outer shelf stations. These groups are subsequently referred to as the Inner Shelf Zone I (20 to 40m), Inner Shelf Zone II (40 to 60m), Outer Shelf Zone I (60 to 80m), and Outer Shelf Zone II (130 to 160m).

Generally, otter trawl clustering tended to include more middle shelf stations (e.g., Stations 11, 23, 29) in the Inner Shelf Zones (e.g., Summer and Winter Cruises) than did triangle dredge clustering. Although both data sets distinguished Stations 23, 29, and 30 as a subset within the outer shelf grouping, otter trawl clustering produced a less consistent grouping of inner shelf stations. Otter trawl clustering produced less consistent clustering patterns between surveys, although the variations themselves did not appear related to season per se. These results could partly be explained by the tendency of the trawls to capture more motile epifauna such as fishes and swimming crustaceans (e.g., penaeid shrimps and portunid crabs) whose ability to move could blur zonation patterns. Lyons and Camp (1982) concluded that clustering on the basis of attached or sessile forms produced more consistent depth-related gradients than if motile species were used. In addition, dredge data consisted of three replicates at each station, which included some frequency-of-occurrence into the weighting for cluster analyses, perhaps enhancing the resulting delineation of faunal zones. This interpretation is supported by the "noisy" results of cluster analysis (not shown) conducted using only single replicate dredges at each station. As discussed in Section 6.5, we believe

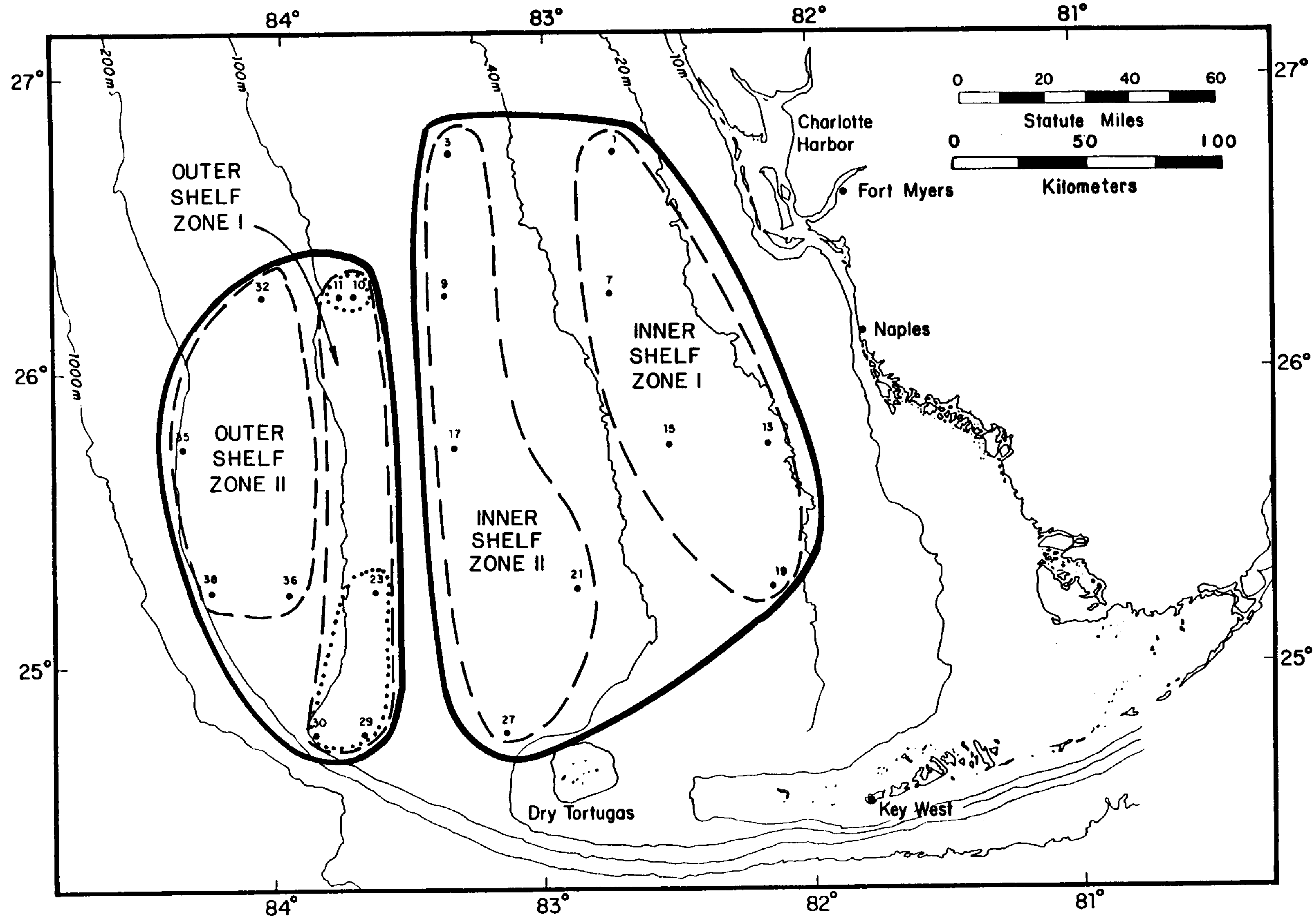


Figure 6-22. General groupings of live bottom stations on the basis of cluster analysis of dredge and trawl data.

that sampling inadequacy for the otter trawls explains some apparent "seasonal" trends and probably accounts, at least in part, for inconsistent or odd shelf-wide zonation patterns resulting from cluster analysis. However, because more taxa were generally captured by dredges than by trawls, inclusion of about the same number of taxa in cluster analyses for each data set required more stringent inclusion criteria (by frequency of occurrence) for dredges. This tended to make the inclusion of taxa that exhibit pronounced seasonality more unlikely in the dredge cluster analysis, contributing to the smoother, more consistent patterns resulting from that analysis.

6.4.4 Evaluation and Discussion of Zonation Patterns

All approaches to delineation of station groupings identified a basic inshore-offshore zonation pattern consisting of a major group of stations at 20 to 70m depths and two or more groups of stations at 60 to 160m depths. Specific station groupings, however, differed depending on the sampling approach. A large grouping of inner and middle shelf stations was evident from both photographic observations and sample collections. Television transect results suggest a grouping of Stations 1, 3, 7, 9, 15, 17, 21, and 27 as the Inner and Middle Shelf Live Bottom Assemblage II, as distinct from the Inner Shelf Live Bottom Assemblage I comprising Stations 13 and 19. The latter two did not emerge as a distinct group in examination of quantitative slide analysis (QSA) results, although Station 13 appeared somewhat unique in having high, patchy levels of gorgonian cover and a blue- green algal bloom during summer; the uniqueness of Station 13 did not emerge in cluster analysis results, in part because the gorgonian species present there were not included (the truncation criteria limited analysis to relatively widely distributed taxa). Several gorgonians (e.g., *Plexaurella* spp., *Eunicea* spp., *Muricea* sp.) were generally restricted to Station 13, and Year Three sampling has subsequently identified gorgonian-dominated assemblages at shallower depths on Transects B, C, and D. Triangle dredge clustering indicated an association between Sections 13 and 19 only once (Spring Cruise). Although QSA results suggest a general similarity of all of the inner and middle shelf stations listed above, ambiguities in the classification of Stations 10 and 11, as well as 9 and 27, were suggested by the results of otter trawl clustering. In addition, several mid shelf stations exhibited similarities (presence of crustose perennial algae and occasional Agaricia sp.) to coralline algal nodule stations, perhaps indicating that assemblages in the 50 to 60m depth range are ecotonal in character.

Cluster analysis of both triangle dredge and otter trawl data suggests depth-related subclustering within the large group of inner and middle shelf stations. Similar station groupings did not emerge in the remote visual assessments, probably because the particular taxa responsible for station groupings (see for example Tables 6-75 and 6-83) were often crustaceans, hard corals, or algae that did not contribute much to total cover values; in addition, the low taxonomic resolution of visual identifications of some groups tends to reduce the ability to distinguish shifts in species composition. On the other hand, unique stations or station groupings noted in examination of QSA results were only occasionally confirmed by clustering of triangle dredge or otter trawl results. Station 1, the most algal-dominated inshore station (in terms of percent cover and number of algal taxa collected), emerged as somewhat distinct in triangle dredge clustering for all cruises combined. Stations 15 and 21, with high and diverse sponge cover, were grouped as similar in cluster analysis of triangle dredge results from the Fall Cruise and otter trawl results from the Summer Cruise.

Analysis of television transect data suggests that a coralline algal nodule-based assemblage occurs at 62 to 108m depths primarily on Transects B, D, and E; Stations 10, 11, 23, and 30 were located in areas characterized by this assemblage. The substrate at these stations ranged from coralline algal nodules over sand (Stations 10, 11, and 23, with the latter having much higher nodule cover) to a coralline algal pavement (Station 30). A related assemblage, the Agaricia Coral Plate Assemblage, occurs at Station 29. QSA data suggest that all of these stations are generally similar, but that Station 29 is unique (Agaricia sp. coral plates; high cover values for A. menziesii) and Stations 10 and 11 are distinct from the others in lacking coverage by the deepwater green alga Anadyomene menziesii and having lower overall cover values. Triangle dredge clustering generally confirmed the taxonomic similarity of Stations 10, 11, 23, 29, and 30 but suggested that Stations 10 and 11 are somewhat more similar to each other than to the others. Cruise-to-cruise variation in the clustering of dredge data from Stations 11, 23, 29, and 30 indicates a likely north-south gradient in taxonomic composition within this station grouping, and some of the otter trawl clustering results suggest an affinity of the northern stations (10 and 11) with Stations 9 and/or 3. Although television transect and QSA data indicate the uniqueness of Station 29 with its *Agaricia*-coral plate assemblage, neither triangle dredge nor otter trawl clustering was able to discriminate consistently between this station and Stations 23 and 30. This probably reflects effects of truncating the data set by frequency of occurrence (*Agaricia* sp. occurred only occasionally in a few other samples) and the limitations of binary (presence/absence) data. In trawl and dredge clustering, taxa comprising a large proportion of total cover, biomass, or numbers carry the same weight in the analysis as relatively rare taxa.

Stations 32 and 36 were selected on the basis of television transect surveys as representative of the Outer Shelf Crinoid Assemblage; Stations 35 and 38 were selected as representative of the Outer Shelf Low-Relief Live Bottom Assemblage. Station 39 constituted a somewhat different station with higher relief and a higher proportion of rock outcrops/hard bottom than that generally attributed to the latter assemblage. QSA data confirm the general affinity of all five stations and the distinctiveness of Stations 35, 38, and 39, which exhibited seasonal (summer) blooms of (unidentified) deepwater green algae. Neither triangle dredge nor otter trawl clustering delineated Stations 35 and 38 as separate from Stations 32 and 36 (no triangle dredge or otter trawl results were available for Station 39). Station 32 did emerge as somewhat different in the summer samples (both dredge and trawl), and apparently had biotal affinities to Station 11 (triangle dredge, Summer Cruise; otter trawl, all cruises combined). Truncation of the data set for cluster analysis may have eliminated taxa that were relatively unique to these deep stations because they were sampled only twice and the assemblage as a whole encompassed few stations (thus, overall frequency of occurrence was likely to be low for taxa characteristic of those stations). The result would be reduced ability to distinguish subsets within the group of deep stations.

Despite the distinctiveness of the coralline algal nodule and <u>Agaricia</u> coral plate assemblages (Stations 10, 11, 23, 29, and 30) from deeper Stations 32, 35, 36, 38, and 39, these groups of stations appeared taxonomically similar in both triangle dredge and (to a lesser extent) otter trawl cluster analyses.

The different types of data collected and the analytical approaches used each have distinct limitations that influence their interpretation. Triangle dredge and otter trawl data are binary (for most taxa), and as such, are insensitive to relative abundance patterns (except insofar as abundance influences the likelihood of capture for a particular taxon); equal weighting of (numerous) rare and (relatively few) common species in a given catch tends to emphasize <u>dissimilarities</u> between stations or samples because rare taxa are the least likely to be adequately sampled. Truncation of the data set by an objective criterion such as overall frequency of occurrence (by station or replicate) tends to overemphasize similarity and underemphasize taxonomically unique stations (or small groups of stations). The major problem with both television transect surveys and QSA data is limited taxonomic resolution; many taxa are not identifiable to species from photographs, and analysis of data grouped into multispecific and multigeneric taxa overemphasizes similarities between samples or stations.

6.4.5 Comparison with Previous Zonation Schemes

Faunal zonation on the west Florida continental shelf has been discussed by Collard and D'Asaro (1973), Lyons and Collard (1974), Hopkins (1979), Lyons (1980), and Lyons and Camp (1982). None of their conclusions are based specifically on data collected only at hard bottom sites. Lyons and Collard (1974) revised the zonation suggested by Collard and D'Asaro (1973), defining a Shoreward Zone (0 to 10m), a Shallow Shelf Zone (10 to 30m), a Middle Shelf Zone I (30 to 60m), a Middle Shelf Zone II (60 to 140m), and a Deep Shelf Zone (140 to 200m). Substrate availability and composition, temperature variability, water clarity, and Loop Current influences were cited as factors responsible for this zonation. Lyons (1980) later revised the depth ranges for the Shallow Shelf Zone (10 to 40m), Middle Shelf Zone I (40 to 70m), and the Middle Shelf Zone II (70 to 140m), based on mollusc data from the Hourglass Cruises. The existence of a faunal break at about 70m was suspected but not supported with specific data; likewise, although the shelf-edge fauna was thought to be unique, the depth range of the faunal break was cited as tentative. Data from several other invertebrate groups and fishes collected during the Hourglass Cruises generally support the existence of these faunal depth ranges (Lyons and Camp, 1982); however, no data were available from stations deeper than about 70m. Hopkins (1979), in reviewing data concerning epibiota collected during the BLM-MAFLA studies, seemed generally to concur with the Lyons and Collard (1974) depth ranges, although pointing out the uniqueness of the Florida Middle Ground in its depth range. Hopkins also suggested that the 60 to 80m depth range may be a transition zone in assemblage composition.

Data from the present study encompass a range of depths from 20 to 160m on the southwest Florida shelf. In general, the results of cluster analysis of dredge and trawl data are consistent with the zonation patterns of Lyons (1980). No data are available for depths corresponding to the Shoreward Zone (0 to 10m). Our Inner Shelf Zones I and II correspond to Lyons' (1980) Shallow Shelf Zone and Middle Shelf Zone I, and provide corroboration for the existence of a faunal break at about 70m. Although our study included stations at 160m depths, no faunal break at or near 140m was evident, but it is still likely that a unique fauna is present nearer the shelf edge. Within our Outer Shelf Zone (70 to 160m), sub-zones were evident--i.e., the 60 to 80m stations (Outer Shelf Zone I) vs. the 130 to 160m stations (Outer Shelf Zone II). This division reflects the occurrence of the coralline algal nodule and Agaricia-coral plate (at Station 29) substrates. Because these substrate types are most extensively developed in the southwest portion of the study area (Stations 23, 29, and 30) and are lacking on Transect A, it is not surprising that a similar biotic zone has not been proposed for the west Florida shelf based on samples taken in the Hourglass study area, which overlaps with our Transect A and extends northward (Figure 6-23).

6.5 SEASONALITY

The shelf is a seasonal environment, though the degree of seasonal environmental variation depends on depth, latitude, and proximity to the shelf edge (see

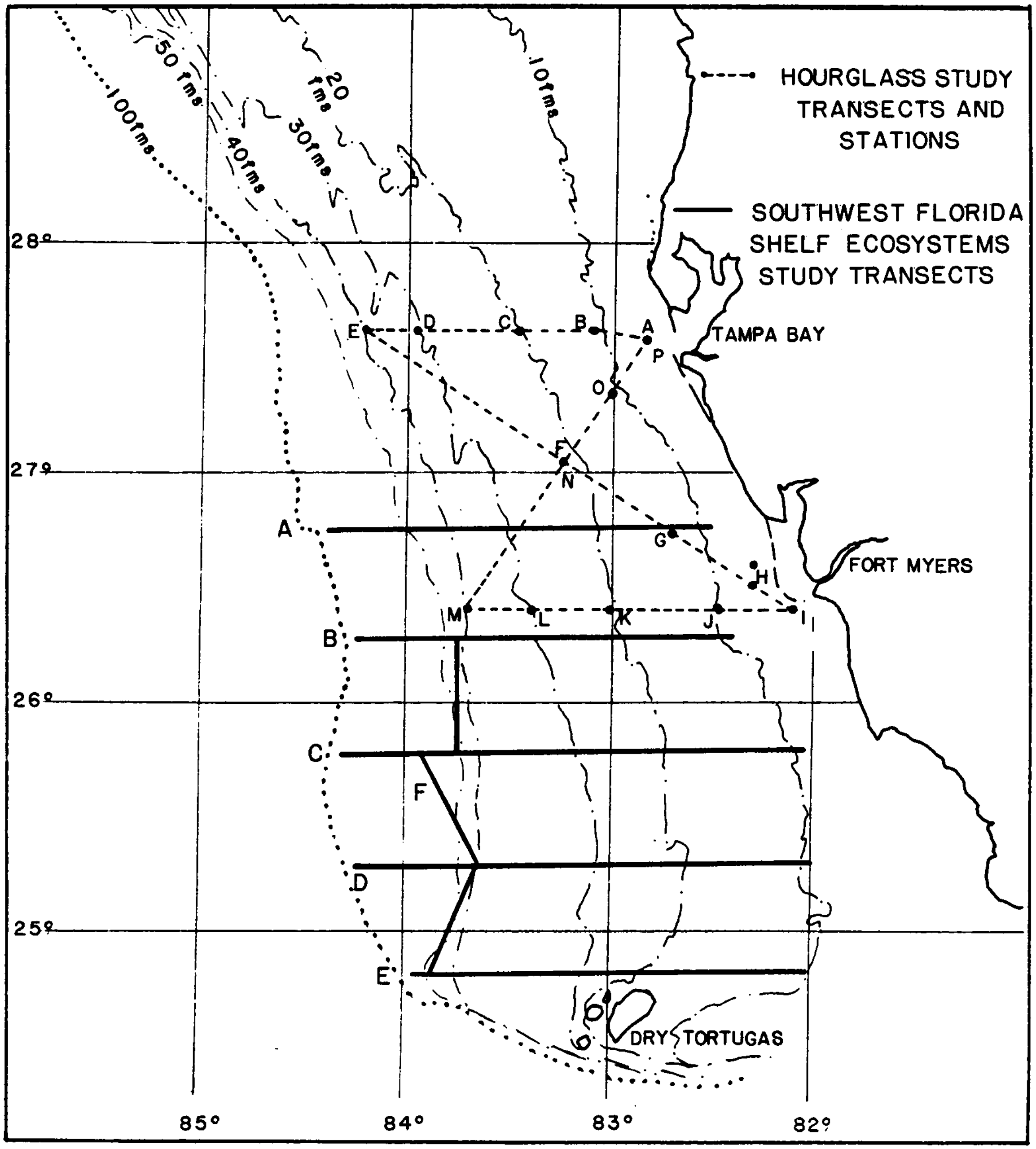


Figure 6-23. Relative locations of the Hourglass study transects and stations and the Southwest Florida Shelf Ecosystems Study transects.

Section 4.0). Temperatures and annual temperature ranges vary strongly with depth and somewhat less with latitude. Temperatures usually remain above 20°C at most inner and middle shelf stations (less than 80m depth) throughout the year, although occasional cold fronts are likely to provide exceptions. Middle and outer shelf stations generally have low seasonal temperature ranges (a few degrees), but outer shelf locations (120 to 160m depth) consistently experience temperatures of less than 18°C; Loop Current-induced upwelling near the shelf edge periodically brings cold, deep waters onto the outer shelf. Other likely seasonal influences include light levels, which should be less variable at lower latitudes and at depths beyond those likely to be influenced by storm or wave-induced, near-bottom turbidity variations; salinity, which may vary seasonally at nearshore areas due to freshwater inputs (e.g, runoff from the Everglades); and food inputs (e.g., particulate organic matter), which are likely to vary depending on seasonal blooms of phytoplankton and seasonal terrigenous sources. These and other potential controlling environmental variables are discussed further in Section 8.0.

The following sections consider evidence for seasonality in live bottom biota, based on variations in taxonomic richness, species composition, and epibiotal cover.

6.5.1 Variations in Taxonomic Richness

One approach to assessing seasonality is to examine variations in taxonomic richness (number of taxa collected at each station) using dredge and trawl data. However, the results must be interpreted with caution. Some stations were sampled only twice (fall and spring, or summer and winter), and the full range of variation may not have been encountered at these stations. In addition, the presence/absence data obtained from dredges and trawls are insensitive to changes in abundance of epibiota; seasonal growth of algae and reproductive periodicity of motile epifauna are only reflected in a reduced likelihood of capture. Finally, as discussed in Section 6.6.3, taxa-saturation curves for triangle dredge samples did not level off at three replicates; therefore, the proportion of total number of taxa actually sampled could have varied with station and season, and some of the "seasonal" variation in taxonomic richness is probably attributable to inadequate sampling. Because taxonomic richness was generally highest at inshore stations, higher apparent seasonality at these stations may partly reflect greater sampling inadequacy at these stations. Otter trawl results are more subject to this problem because only one replicate was obtained at each station and therefore sampling adequacy could not be estimated. Otter trawls generally captured fewer taxa at a given station/cruise, and the degree of cruise-to-cruise variation was greater than for dredge samples. Because most trawl taxa (with the obvious exception of fishes) were also obtained in dredges, the following discussion relies primarily on dredge data.

Most stations exhibited significant seasonal variations in taxonomic richness; at the 10 stations that were sampled on all four cruises, the number of total dredge-collected taxa was generally highest during summer (five stations) or fall (three stations) and lowest during winter (seven stations) (Figure 6-24); results of trawl sampling produced less consistent seasonal patterns (Figure 6-25). In dredge data, the highest degree of (relative) seasonal variability in total taxa was noted at Station 7, and low variability was noted at Stations 17, 23, 35, 36, and 38. In otter trawl data, Stations 1, 3, 13, 15, 19, 30, and 32 exhibited high seasonal variability and Stations 11, 17, 23, 29, 36, and 38 had relatively low variability. These results suggest a general (though not consistent) trend of decreasing seasonal variability in taxonomic richness with depth and/or distance from shore.

Different taxonomic groups exhibited different degrees of seasonal variability in taxonomic richness. Major groups considered below are the algae, crustaeans, sponges, and molluscs, which together contributed 57% of total taxa collected by dredge and 54% of total taxa collected by trawl.

Algal taxonomic richness showed strong seasonal variations, especially at inner shelf stations (Figure 6-26). Generally, at inner and some middle shelf stations (1, 3, 7, 9, 13, 17, 19, and 21), the number of algal taxa (dredge and trawl data combined) exhibited distinct seasonal patterns, with the largest number of taxa occurring during summer (or fall) and the lowest during winter (or spring). At several middle shelf stations (11, 15, 23, and 29), a higher

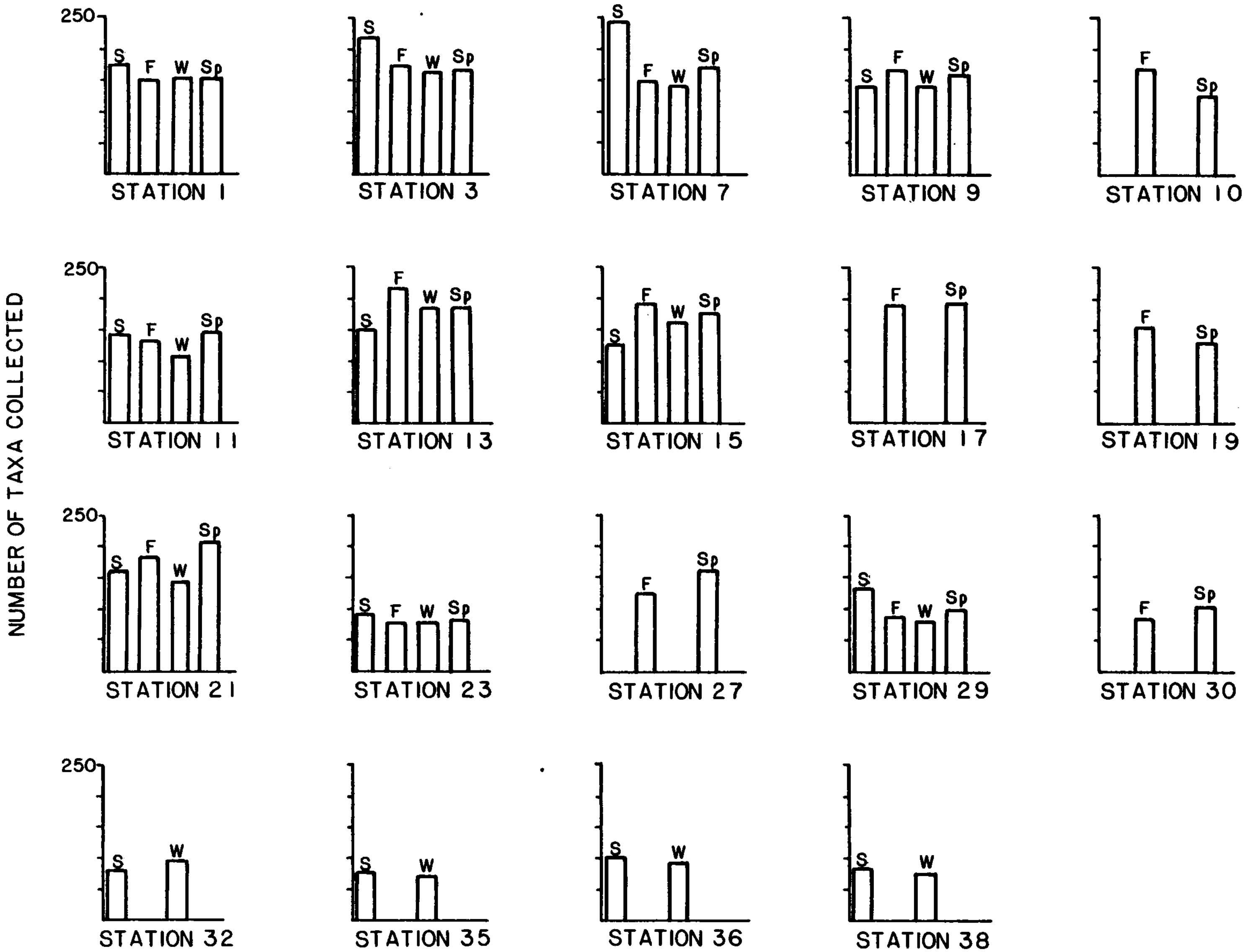


Figure 6-24. Seasonal variation in the number of total taxa collected in dredge samples at live bottom stations. Only taxa identified to genus or species are included. S=Summer, F=Fall, W=Winter, Sp=Spring.

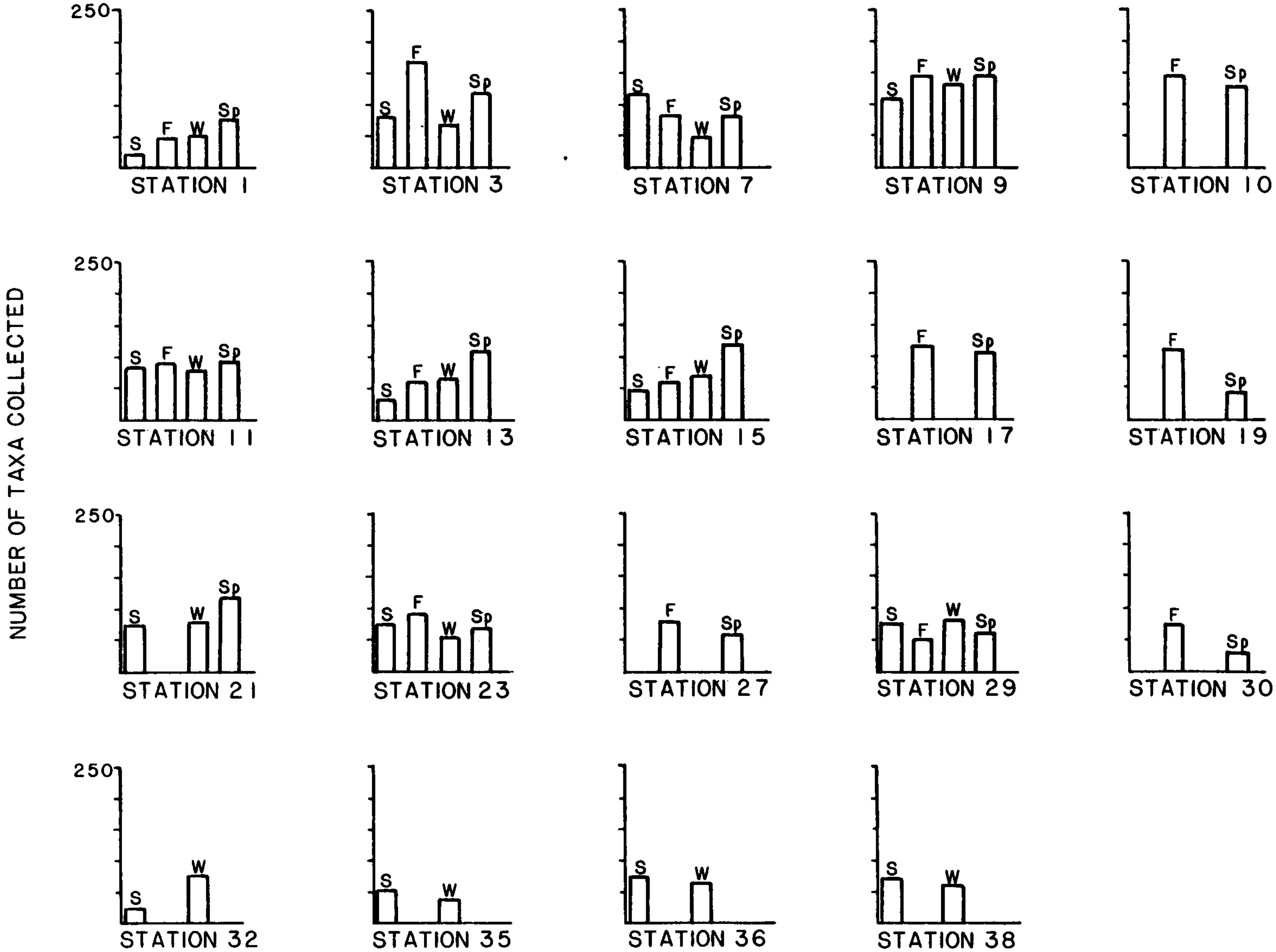


Figure 6-25. Seasonal variation in the total number of taxa collected in trawl samples at live bottom stations. Only taxa identified to genus or species are included.

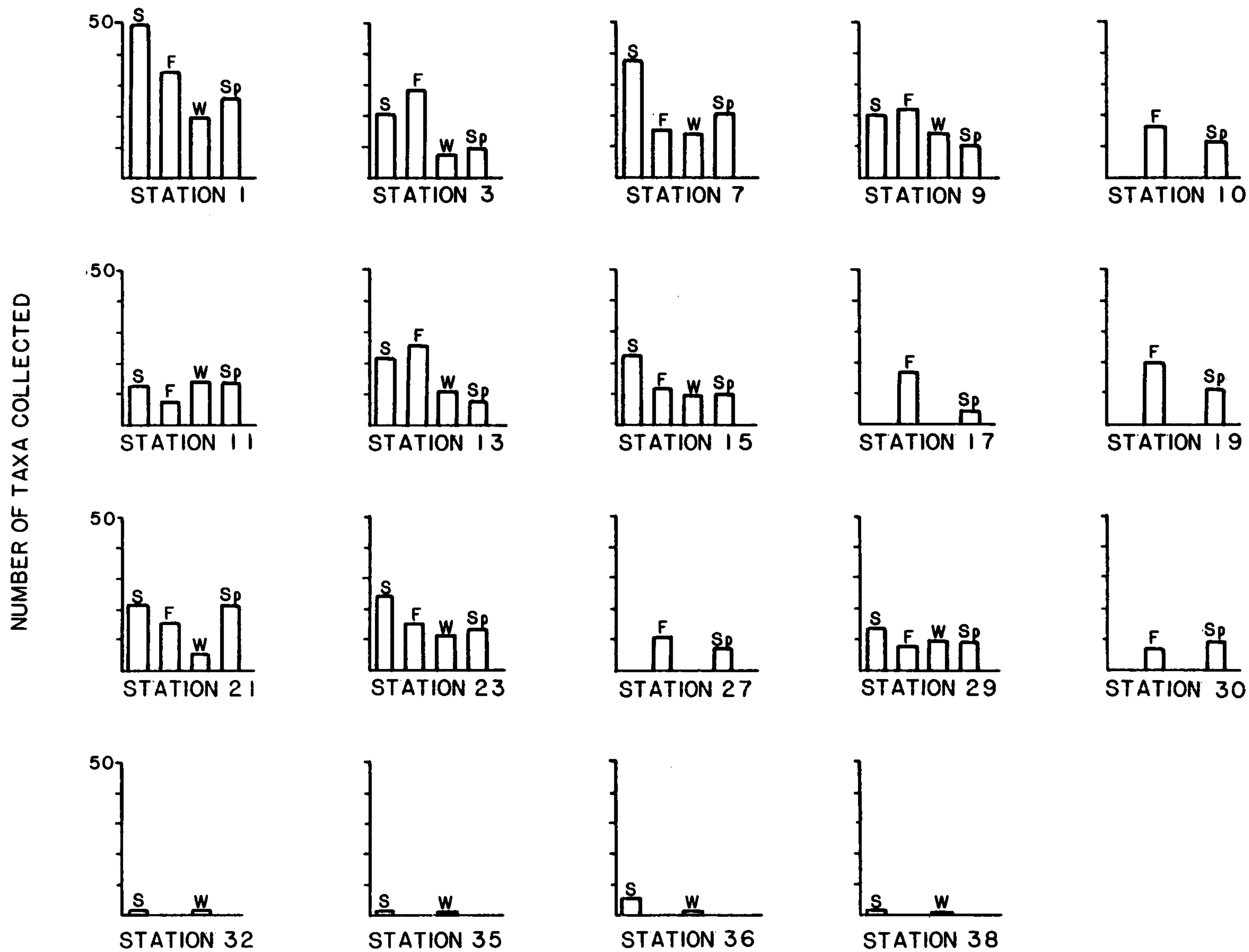


Figure 6-26. Seasonal variation in the number of algal taxa captured in dredges and trawls at live bottom stations. Only taxa identified to genus or species are included.

proportion of the taxa were apparently perennials (e.g., Halimeda sp., Peyssonnelia spp., etc.), although there was an increase in the number of algal taxa present at the latter three stations during summer; a similar pattern probably occurs at Stations 27 and 30, which were not sampled during summer. At deep, outer shelf stations (32, 35, 36, and 38), very few algal taxa were captured, precluding an assessment of seasonality. It is worth noting, however, that several deepwater species that were perennials at other stations, including Anadyomene menziesii, Struvea pulcherrima, and cryptonemialid red algae, were among those captured or observed at one or more of the deep outer shelf stations.

The number of crustacean taxa collected also varied at many stations (Figure 6-27), though in general far less than did the algae. In dredge samples at the 10 stations sampled on all four cruises, the highest number of taxa was generally obtained in summer (five stations) and the lowest number was generally present during winter (five stations); however, at Stations 1, 15, and 21, the lowest number of taxa was obtained during summer and the highest was obtained during fall. Variability in the number of dredge-collected taxa was high at Stations 15, 21, 29, and 35 and relatively low at Stations 3, 9, 10, and 13. The data do not suggest any general shelfwide trend in seasonality of crustacean taxonomic richness. The low number of crustacean taxa at Stations 29 and 30 may partly reflect sampling difficulties associated with the algal nodule pavement/coral plate substrate at these stations. Seasonal variations in crustacean taxonomic richness probably reflect both seasonal abundance patterns that can influence the likelihood of capture, as well as differences in sampling adequacy.

Some cruise-to-cruise variation in the number of dredge-collected sponge taxa collected was evident (Figure 6-28). At Stations 9, 11, 13, 15, and 21, more taxa were collected on the Fall and Spring Cruises than on the Summer and Winter Cruises, whereas at Stations 1, 3, 7, 23, and 29, more consistent seasonal patterns were noted, even though the variations were relatively small. Variability was relatively pronounced at Stations 9, 10, 11, 13, 15, and 30, and was relatively low at Stations 1, 19, 21, 23, 29, 36, and 38. These re-

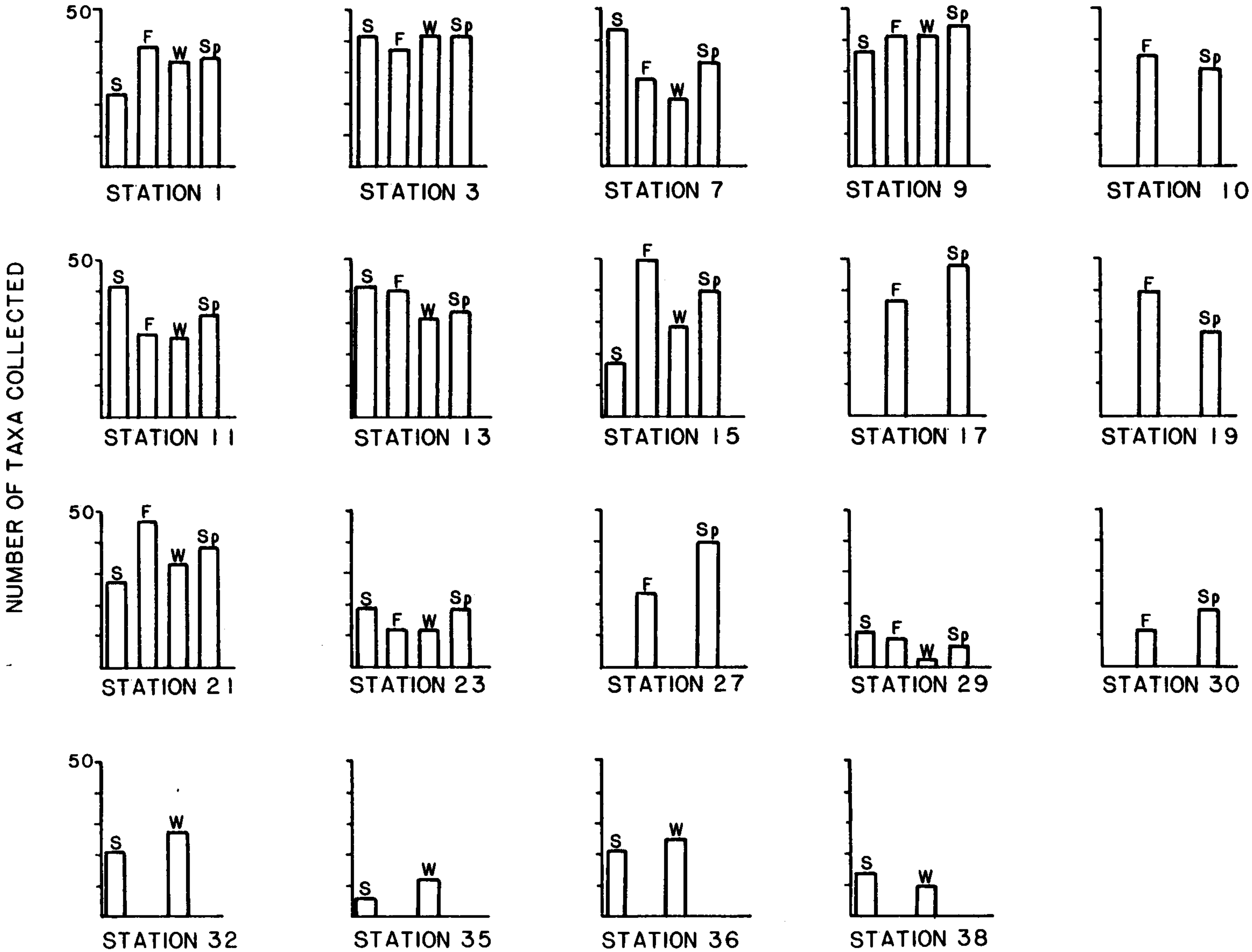


Figure 6-27. Seasonal variations in the number of total crustacean taxa collected in dredge samples at live bottom stations. Only taxa identified to genus or species are included.

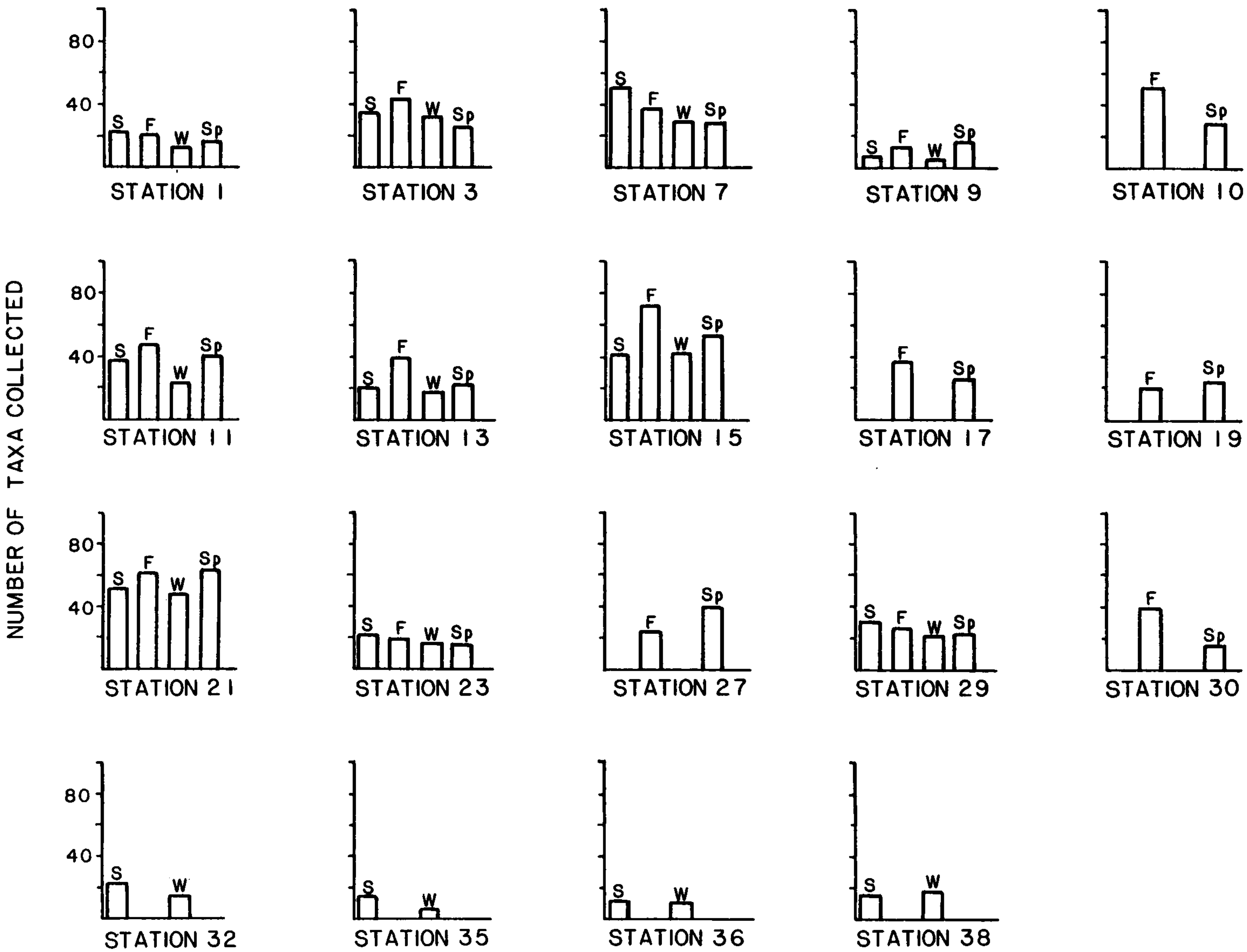


Figure 6-28. Seasonal variations in the total number of sponge taxa collected in dredge samples at live bottom stations. Only taxa identified to genus or species are included.

sults do not suggest any general shelfwide trend in variability of the number of sponge taxa.

The number of mollusc (mostly gastropod) taxa (Figure 6-29) varied significantly between seasonal samples at most stations, but not in a consistent pattern. At Stations 1 and 3, the number of taxa collected was much higher in summer and winter than in fall and spring, whereas at Stations 7, 11, 13, 15, 21, and 29, more plausible seasonal trends were evident. Variability was high at Stations 1, 3, 7, 13, 15, 29, 32, and 38 and relatively minimal at Stations 9, 10, 11, 17, 23, 27, and 36. Thse results suggest that seasonal variability in molluscan taxonomic richness is generally minimal at middle shelf depths (55 to 80 m), but because relatively few taxa were captured at outer shelf stations (32, 35, 36, and 38) and at Stations 29 and 30, it is difficult to evaluate the likelihood of real changes at those stations.

6.5.2 Variations in Taxonomic Composition

Seasonal variations in the taxonomic composition of assemblages at live bottom stations can be assessed by examining normal cluster analysis results for all stations/seasons combined, as presented in Sections 6.4.3.1 and 6.4.3.2. However, the examination of cluster analysis results using presence-absence data from dredge and trawl sampling tends to underemphasize seasonality because: 1) several of the groups contributing the largest number of taxa, such as sponges and associated crustaceans, are not as likely to exhibit strong seasonality of occurrence as are the algae, which comprise far fewer taxa; and 2) use of truncation criteria limiting consideration to widely distributed and/or consistently present taxa underemphasizes the contribution of highly seasonal taxa, especially those that are limited in distribution to a few stations. The latter problem is more likely to affect dredge sample results than trawl results because a larger number of species were collected in the dredges and therefore a smaller proportion of the total was included in each cluster analysis (see Table 6-67).

The station/season dendrogram for triangle dredge data (see Figure 6-14) shows that seasonal variations in overall taxonomic composition at individual sta-

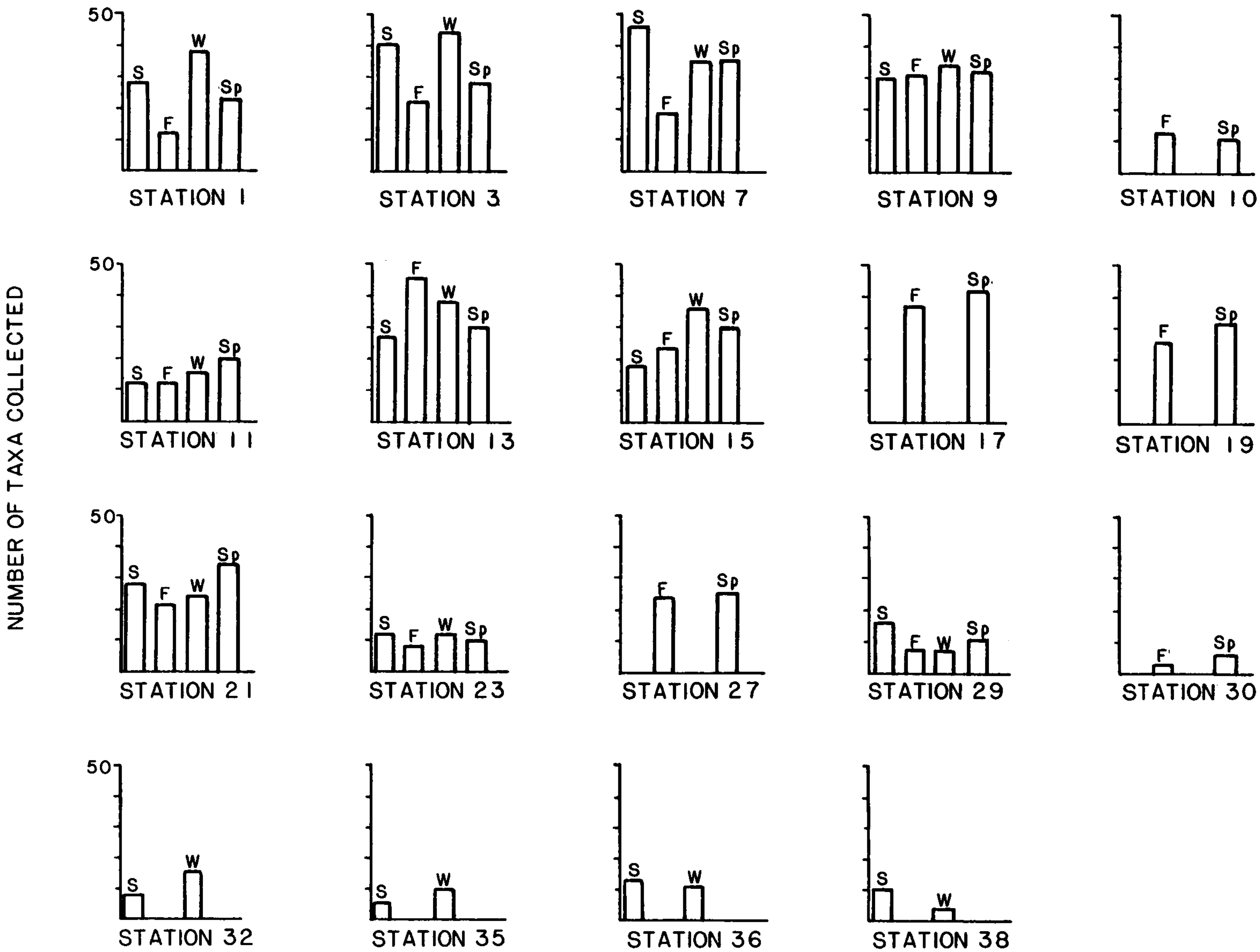


Figure 6-29. Seasonal variations in the total number of molluscan taxa collected in dredge samples at live bottom stations. Only taxa identified to genus or species are included.

tions were generally less than the between-station variations. Station 13 had the highest degree of dissimilarity among seasonal samples, whereas Station 15 had the lowest. The results appear to bear no consistent relationship to depth or latitude.

The dendrogram for otter trawl results (Figure 6-21) shows a much higher degree of "seasonal" variability in taxonomic composition. For example, Summer Cruise results for Stations 1 and 13 clustered out separately from all other seasons for those stations, and at Stations 3 and 11, the results for the Fall and Spring Cruises clustered separately from those of the Summer and Winter Cruises. This may be due, in part, to the inclusion of a higher percentage of total taxa in the trawl clustering than in dredge clustering (i.e., the criteria were less likely to result in the deletion of occasional or seasonal taxa). Two other likely explanations can be posed. The first is that otter trawls sample a different suite of taxa (e.g., fishes) that are more seasonally variable than those obtained by dredges. The second is that single otter trawls provide a more inadequate assessment of the total taxa present than do replicated dredges. The first hypothesis is supported by the observation that, on the average, 40% of trawl taxa collected at any given station were not also collected in dredges (the figure for all taxa combined over stations and seasons is 20%, however), and fishes constituted the single largest contributor to this group of unique taxa. However, the second hypothesis appears likely to explain much of the observed "seasonal" differences in taxonomic composition. First, at the stations showing the highest degree of seasonal differences (3 and 11), the Summer and Winter Cruise results clustered apart from the Fall and Spring results, an odd relationship to be interpreted as a seasonal pattern. Also, examination of two-way occurrence tables for trawl-collected taxa included in cluster analysis reveals that at Station 11 (the most "seasonally" variable station), most taxa present exclusively in one station/season cluster were not fishes (most were sponges) and nearly all were caught in dredge samples at the same station/season combination when they were not caught in trawls (Table 6-84). Therefore, these taxa were not necessarily seasonal in their occurrence; rather, trawl sampling was not adequate to ensure their collection during all seasonal surveys. Unfortunately, the sampling inadequacy of trawls with respect to fishes cannot be similarly assessed by comparison to dredge re-

Table 6-84. List of "seasonal" trawl-collected taxa at Station 11, showing that seasonality of occurrence was apparently due to sampling inadequacy of the trawls.

Taxa Collected in Otter Trawls in Fall and Spring Only*	Collected in Triangle Dredge Samples for Summer or Winter?
Bubaris spp. (sponge)	Yes (summer, winter)
Cinachyra alloclada (sponge)	No
Ircinia strobilina (sponge)	Yes (summer, winter)
Placospongia melobesioides (sponge)	Yes (summer, winter)
Stephanoscyphus corniformis (scyphozoan)	Yes (summer, winter)
Aglaophenia elongata (hydrozoan)	Yes (summer, winter)
Stenocionops furcata furcata (decapod)	Yes (summer, winter)
Taxa Collected in Otter Trawls in Summer and Winter Only	**Collected in Triangle Dredge Samples for Fall or Spring?**
Processa tenuipes (crustacean)	No
Eudistoma capsulatum (ascidian)	Yes (spring)

*The Fall and Spring Cruise trawl results clustered separately from Summer and Winter Cruise results at this station.

sults. Therefore, at Station 15 for example, where the Spring Cruise results clustered out separately from all other seasons, results are only partially explainable by showing that certain sponge, bivalve, echinoderm, and algal taxa uniquely present or absent in the spring trawl sample were obtained in dredges (Table 6-85). Uniquely present or absent fish species could have occurred seasonally--or sampling may have been inadequate to obtain them on all sampling dates.

The difficulty in discerning clear seasonal patterns from cluster analysis results reflects, in part, the variety of seasonal patterns of abundance and/or occurrence at different stations that are evident for different species. Figures 6-30 through 6-32 illustrate seasonal patterns of station occurrences for some frequently collected fishes (the dusky flounder *Syacium papillosum* and the offshore lizardfish *Synodus poeyi*) and for the green alga *Cystodictyon pavonium*. Both fish species occurred at the highest number of stations during spring, when they were collected at the shallow inshore stations (1 and 13) as well as several others; occurrence was limited to deeper mid shelf stations during fall and winter. The green alga *Cystodictyon pavonium* was present year-round at mid-depth stations (3 and 21) and extended inshore to Stations 1 and 13 only during winter. Figure 6-33 shows seasonal station occurrences of the sea urchin *Arbacia punctulata* as derived from dredge vs. trawl sampling. In general, dredge sampling resulted in the collection of the urchin at more stations/seasons than did trawl sampling, and the shelfwide distribution patterns of the animal were more likely to be misrepresented using trawl data.

6.5.3 Variations in Epibiotal Cover

Shelfwide variation in average epibiotal cover has been presented in Figure 6-4. The seasonal range in cover (Figure 6-34) was low at Stations 7, 9, 17, 27, 30, and 32, and highest at Stations 13, 23, and 39. Figure 6-35 shows the range scaled by average cover to allow comparison of proportional changes in cover. The highest proportional variations in cover were observed at Stations 3, 11, 13, and 21; the lowest were noted at Stations 7, 29, 30, and 32.

Table 6-85. List of "seasonal" trawl-collected taxa at Station 15, showing that apparent seasonality was at least partly due to sampling inadequacy of the trawls.

Taxa Collected in Otter Trawls in Spring Only*	Collected in Triangle Dredge Samples for Summer or Winter?
Lithothamnium calcareum (coralline alga)	Yes (fall, winter)
Sargassum sp. (brown alga)	No
Thyroscyphus marginatus (hydrozoan)	No
Aequipecten muscosus (bivalve)	Yes (summer, winter)
Tozeuma serratum (decapod)	No
Arbacia punctulata (echinoid)	Yes (fall, winter)
Prionotus roseus (fish)	No
Synodus poeyi (fish)	No
Pristigenys alta (fish)	No
Taxa Collected in Otter Trawls in Summer, Fall, and Winter but not Spring	**Collected in Triangle Dredge Samples for Fall or Spring?**
Ircinia strobilina (sponge)	Yes (spring)

*The Spring Cruise trawl results clustered separately from all other trawl results at this station.

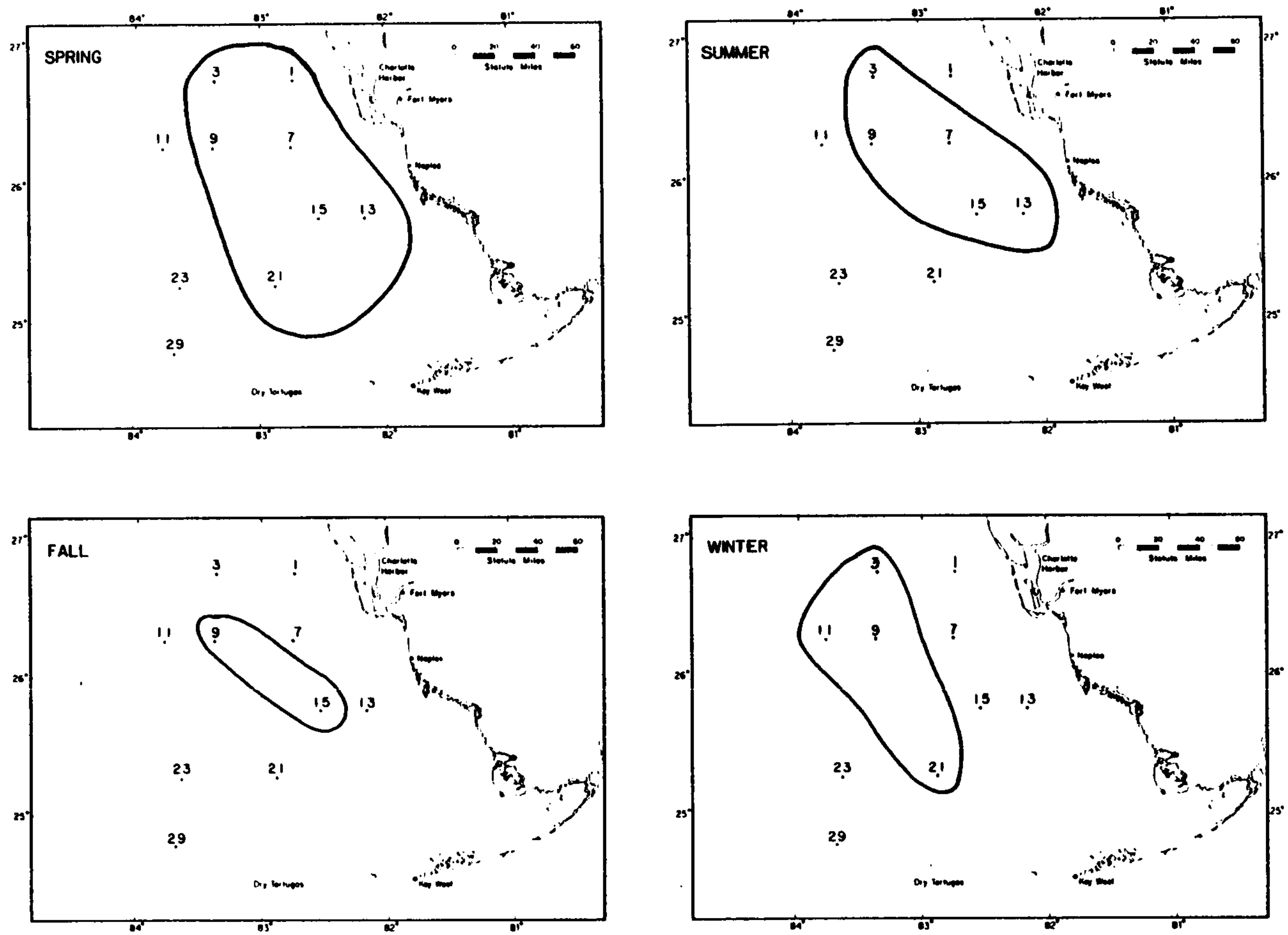


Figure 6-30. Seasonal variations in station occurrences of the dusky flounder, *Syacium papillosum*, based on trawl data. Only stations that were sampled on all four seasonal cruises are included.

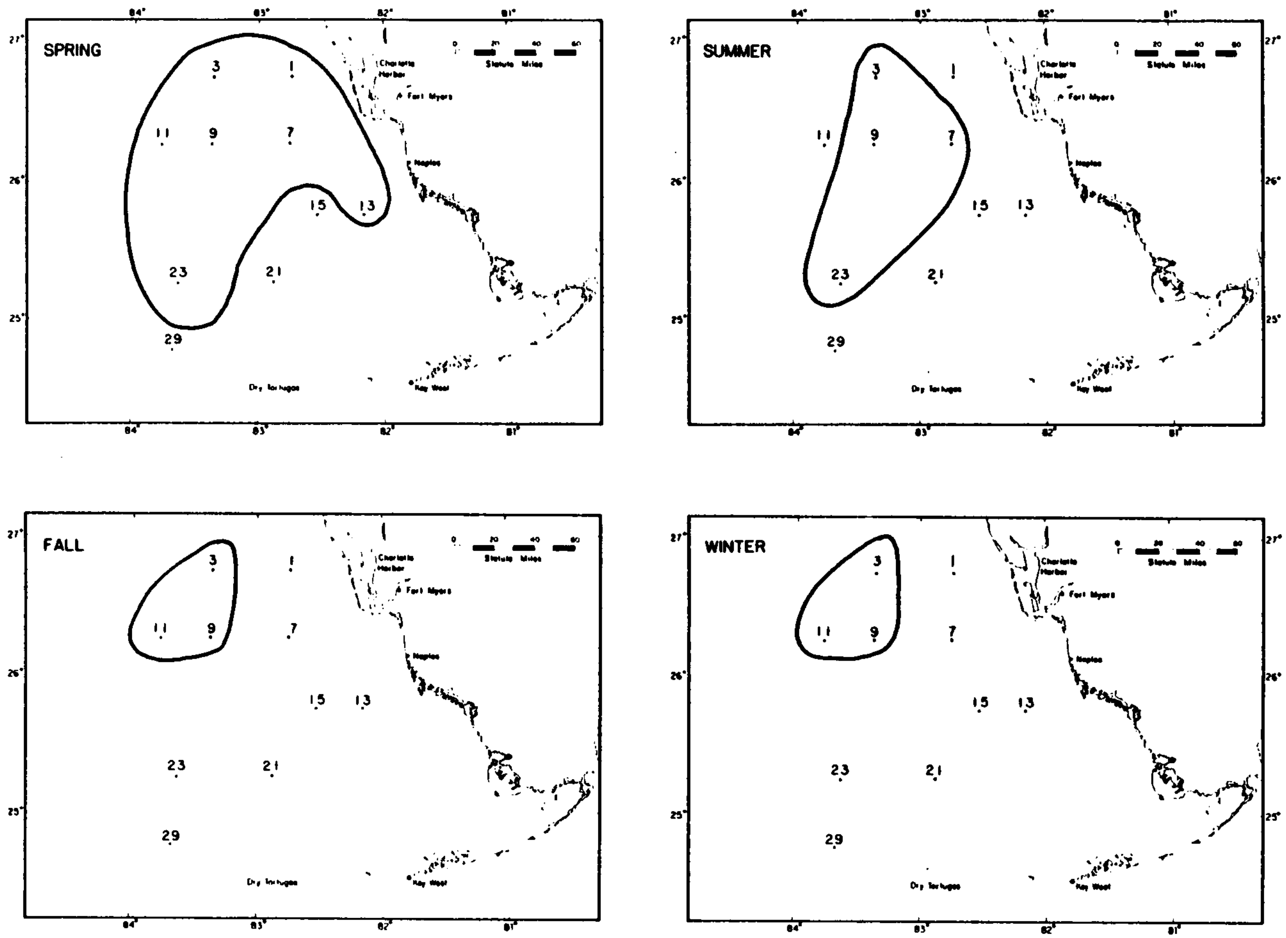


Figure 6-31. Seasonal variations in station occurrences of the inshore lizardfish, Synodus poeyi, based on trawl data. Only stations that were sampled on all four seasonal cruises are included.

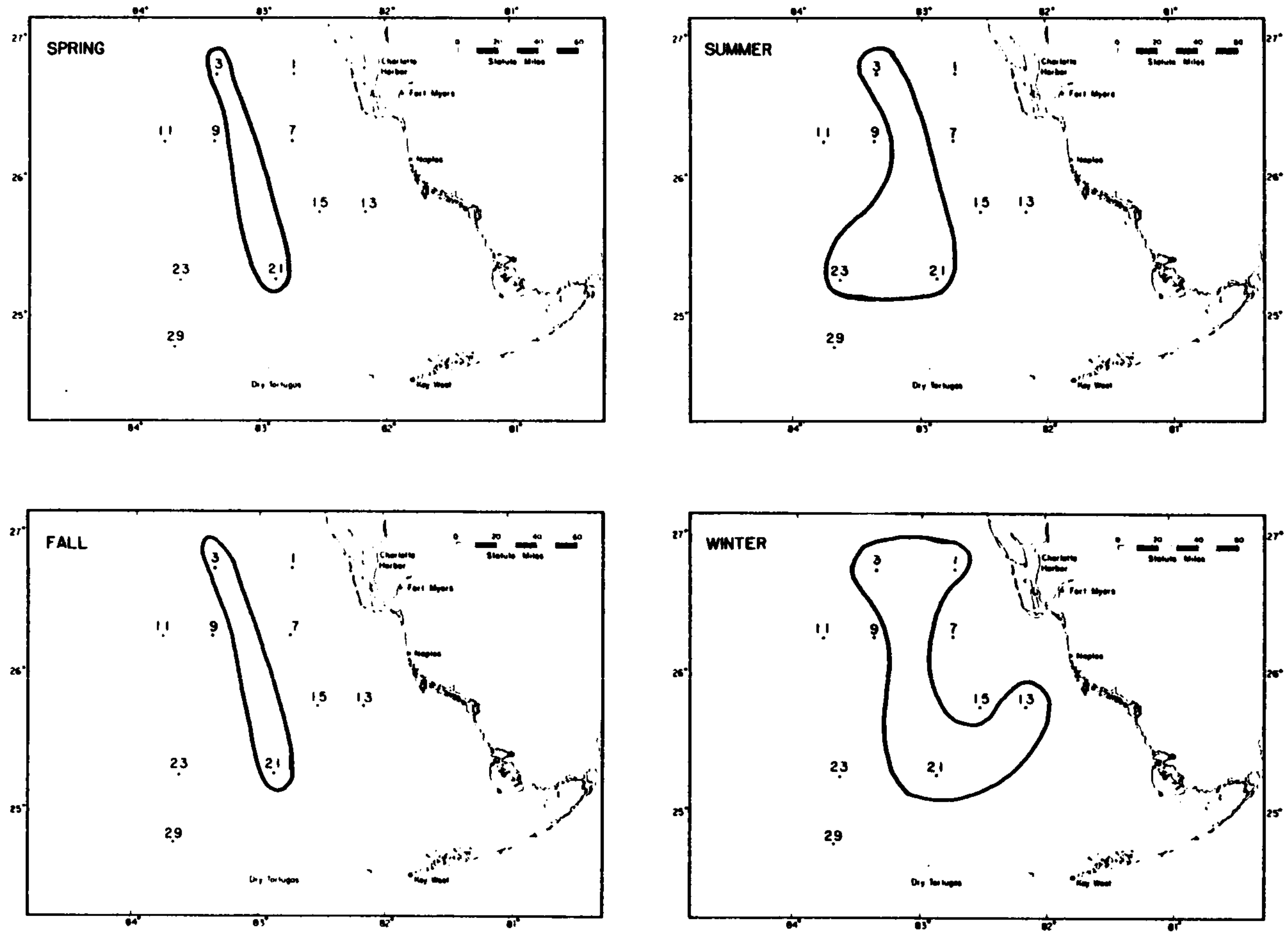


Figure 6-32. Seasonal variations in station occurrences of the green alga <u>Cystodictyon</u> <u>pavonium</u> based on trawl and dredge data. Only stations that were sampled on all four seasonal cruises are included.

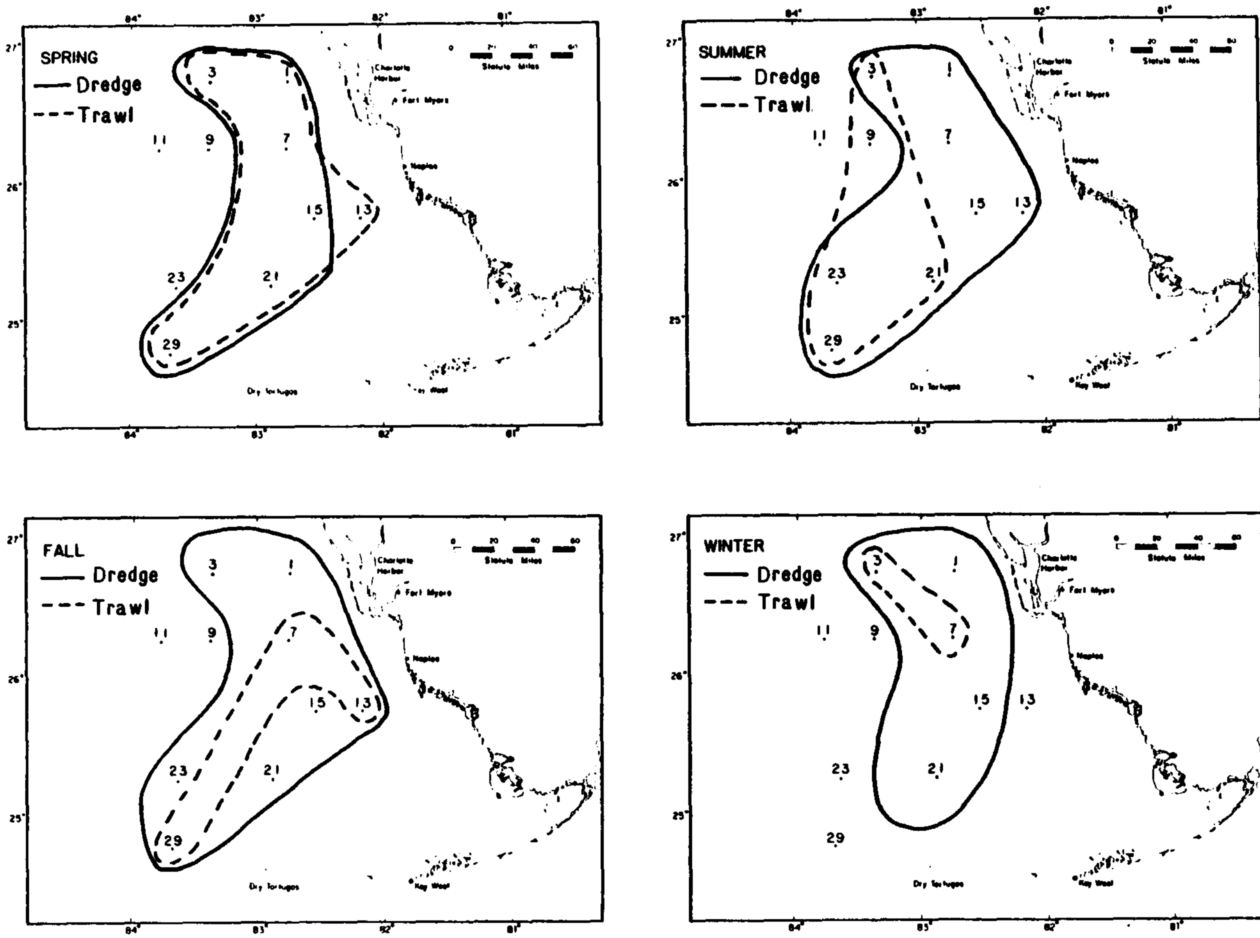


Figure 6-33. Comparison of station occurrences of the sea urchin Arbacia punctulata on the basis of dredge vs. trawl sampling. Only stations that were sampled on all four cruises are included.

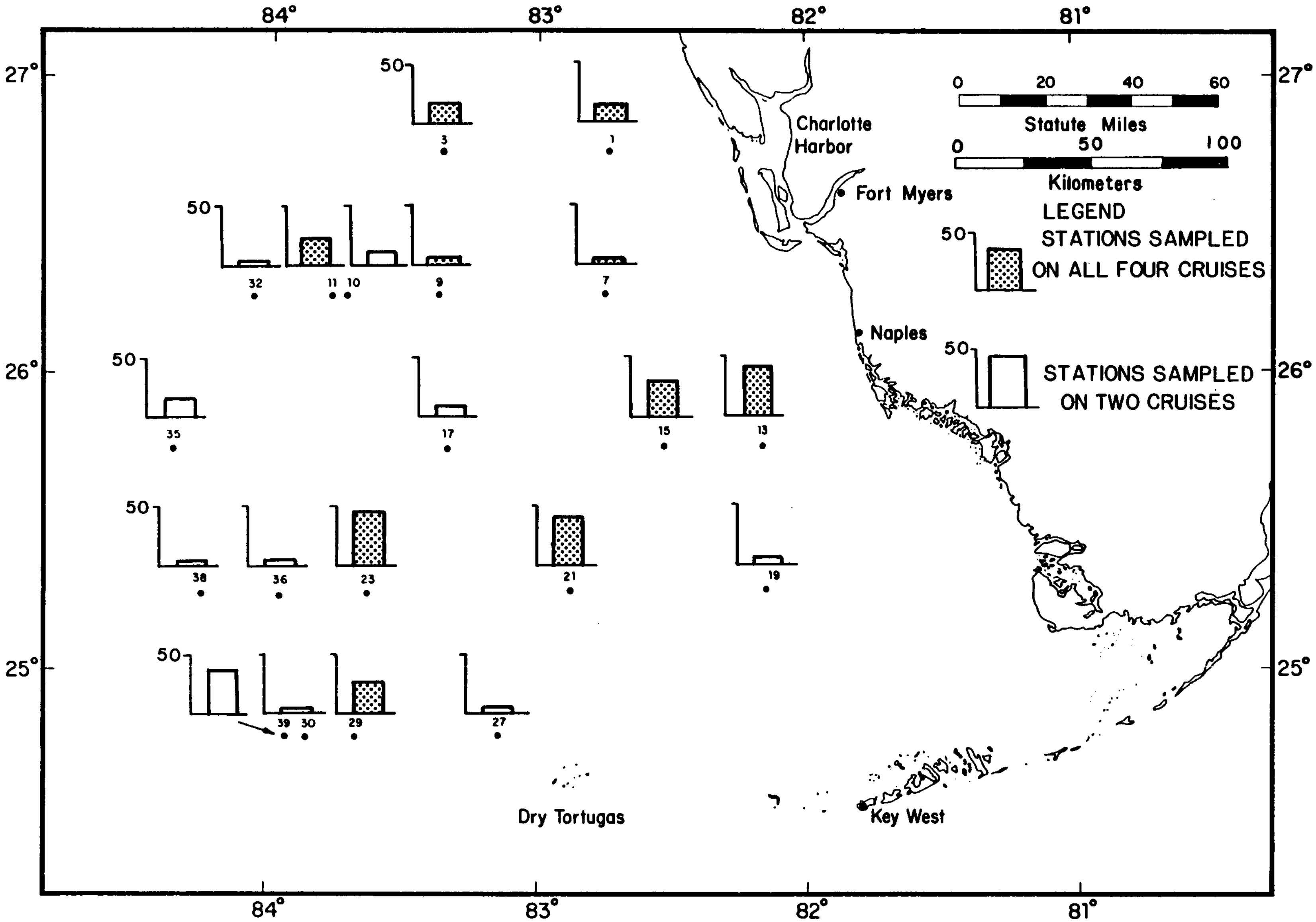


Figure 6-34. Range (maximum-minimum) in percent epibiotal cover at live bottom stations, as determined by quantitative slide analysis.

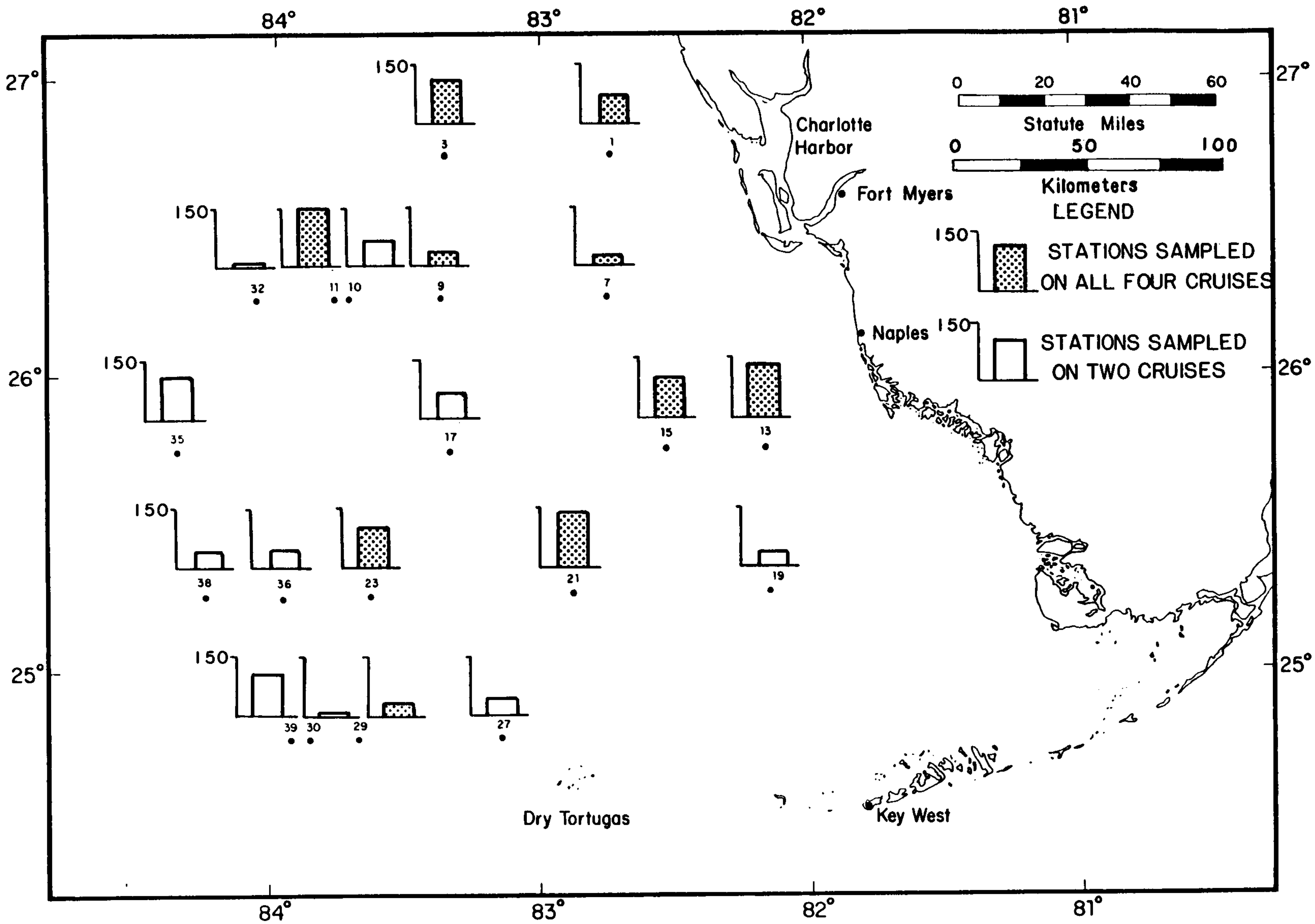


Figure 6-35. Relative range [(maximum-minimum)/(average)] x 100 in percent epibiotal cover at live bottom stations.

No consistent pattern emerges from these simple illustrations of changes in total cover. This is partly due to the incomplete sampling pattern--i.e., some stations were sampled all four seasons, whereas others were sampled during only fall and spring or summer and winter. Some changes probably also reflect spatial variation within a station rather than true changes in cover. Another factor is the wide variety of underlying seasonal patterns of various groups. At Station 1, for example, algae were the dominant cover in all seasons and blooms of various groups were responsible for the variability observed. At Station 9, in contrast, algae dominated cover but the seasonal patterns of abundance of different groups and the significant contribution by the perennial green alga *Halimeda* sp. produced a nearly constant total cover value. At several stations (e.g., Stations 3, 15, and 21), sponges were significant or primary contributors to total cover during several seasons but a seasonal bloom(s) of algae was responsible for most of the noted variation in total cover. A similar pattern was noted at the deepest stations (35 and 38), although sponges were not necessarily the primary non-algal cover. At some mid shelf stations (e.g., Stations 11, 23, and 30), cover was dominated by perennial red algae (*Peyssonnelia rubra*, *P. simulans*, and other Cryptonemiales) and/or *Anadyomene menziesii* (also *Agaricia* sp. corals at Station 29), but seasonal changes in red and green algal cover produced most of the observed variation.

Consistent seasonal patterns of abundance were noted for various algal groups. Generally, rhodophytes (other than Cryptonemiales) apparently bloomed during summer at most inshore stations (Figure 6-36), and red algal cover was generally highest during summer even at those stations dominated by crustose perennials (Stations 11, 23, and 29). Chlorophyte cover was also generally highest during summer, and sometimes, fall (Figure 6-37). Phaeophyte cover was often maximal in spring (Stations 1, 3, 9, 10, and 17), and sometimes, fall (e.g., at Stations 13 and 21) (Figure 6-38); the brown algae were never very abundant at mid to outer shelf stations. Often most of the cover attributed to a particular group could not be assigned to a particular genus or species on the basis of photographic analysis, making interpretation difficult. For example, phaeophyte cover was often maximal when only one or two species (or none) were captured in dredges or trawls. Therefore, it is uncertain whether the varia-

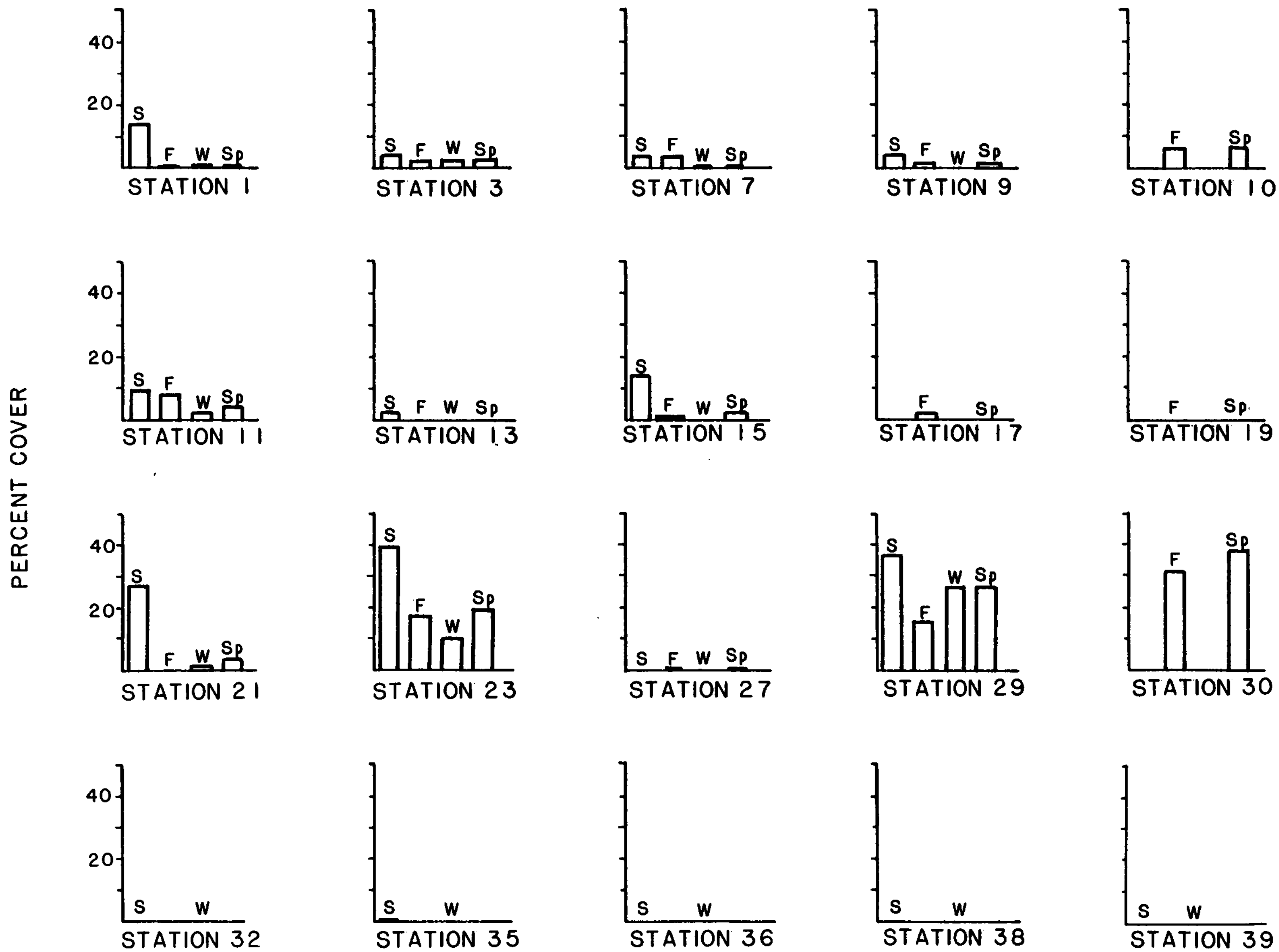


Figure 6-36. Seasonal variation in percent cover estimates for red algae (Rhodophycophyta) at live bottom stations. S=Summer, F=Fall, W=Winter, Sp=Spring Cruises.

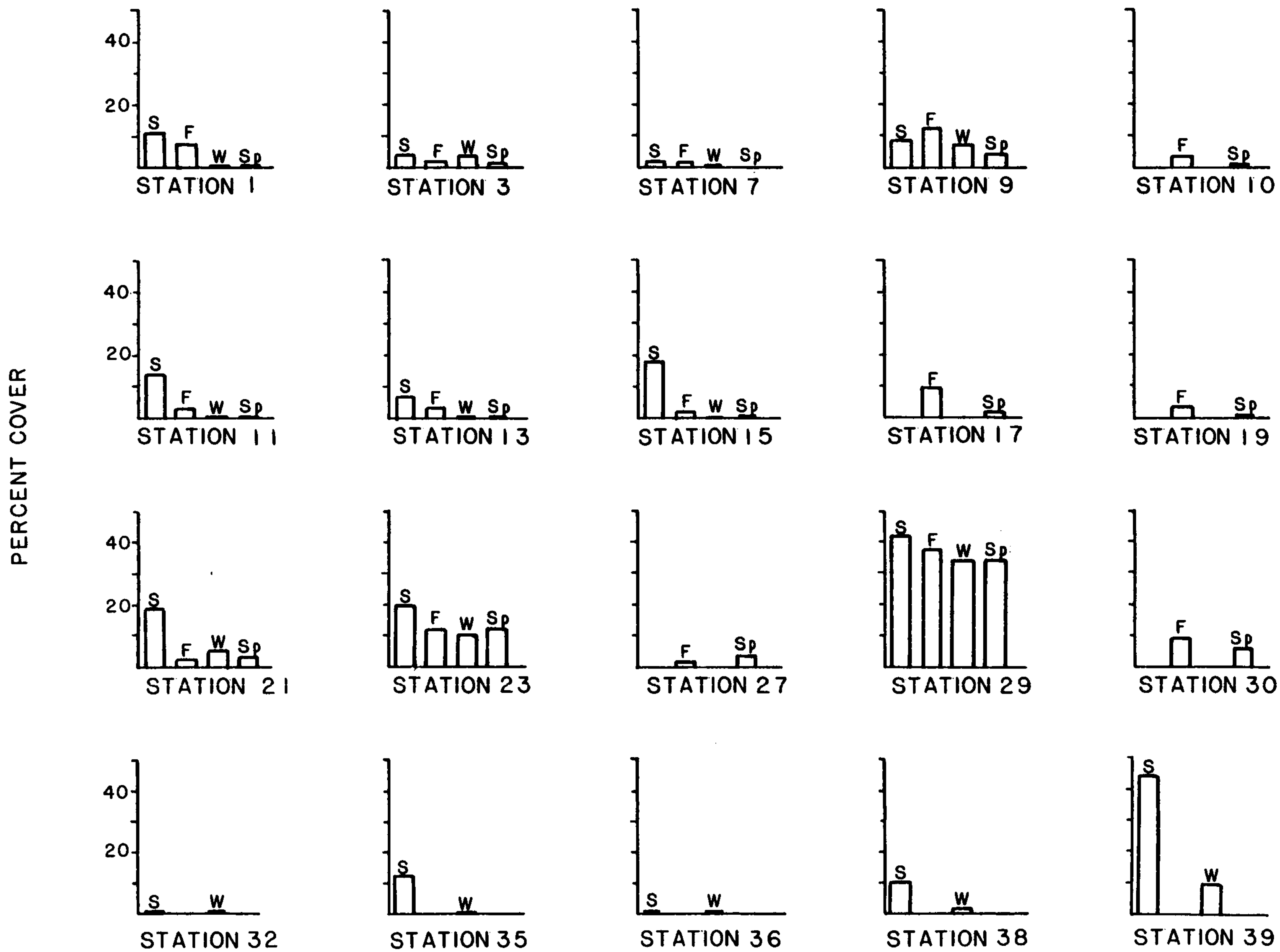


Figure 6-37. Seasonal variation in percent cover estimates for green algae (Chlorophycophyta) at all live bottom stations.

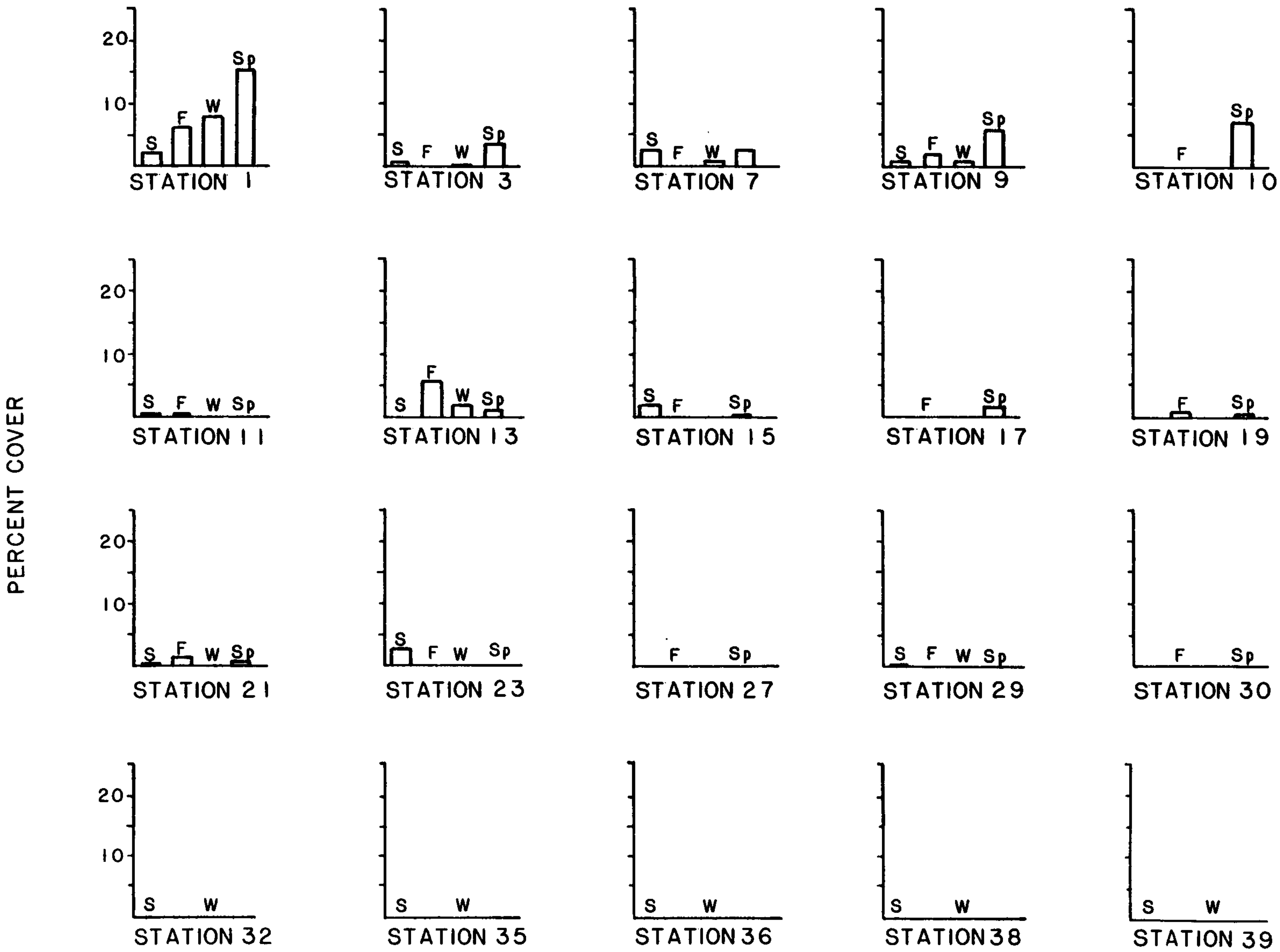


Figure 6-38. Seasonal variation in percent cover estimates for brown algae (Phaeophycophyta) at live bottom stations.

tion in algal cover observed in many cases is due to one highly abundant species or to a general bloom of many.

In addition to the marked seasonality of algal groups at the inshore stations, there was a component of perennial green (*Halimeda* sp.; *Anadyomene menziesii*) and/or red (*Peyssonnelia* spp. and others) algae at some deeper stations. *Halimeda* sp. was very abundant year-round at Stations 9 and 23; red cryptonemialid algae were year-round components at Stations 10, 11, 23, 29, and 30; and *A. menziesii* was present at nearly constant levels during all seasons at Stations 23, 29, and 30. Other unidentified green algae were present at the deepest stations (Stations 35, 38, and 39) but these were seasonal in their abundance. Cryptonemialid red algae contributed a minor amount of cover at several of the deep stations.

Total sponge cover estimates (Figure 6-39) varied seasonally at some stations. In some cases this probably reflects changes in algal abundance; when algae were abundant, they often masked underlying epibiota. Thus, for example, the lowest values at Stations 3, 7, and 21 were noted when algal cover was maximal. At other stations (e.g., Stations 7 and 11) the highest values were noted when algal cover was minimal. At Stations 1, 9, and 29, sponge cover was low and variations probably reflect sampling error. Four of the deep outer shelf stations (32, 35, 36, and 39) exhibited considerably higher sponge cover in summer than winter. In the case of Stations 32 and 35, the estimates are suspect because so few slides (17 and 18, respectively) were obtained (see Section 6.6.3).

In a few instances, other groups exhibited distinct seasonal variations in abundance. The most dramatic changes were the abundance of crinoids at Stations 32 and 36 (much higher in winter than summer), and the abundance of gorgonians at Station 13 (much higher in winter than summer). The low number of slides available from the Winter Cruise for Stations 32 and 35 (17 and 18, respectively; the low number was due to technical problems with the camera system) makes the values at those stations suspect, both in terms of precision (coefficient of variation) and accuracy (degree to which the number of samples was adequate to average over patchiness at a station and produce a good esti-

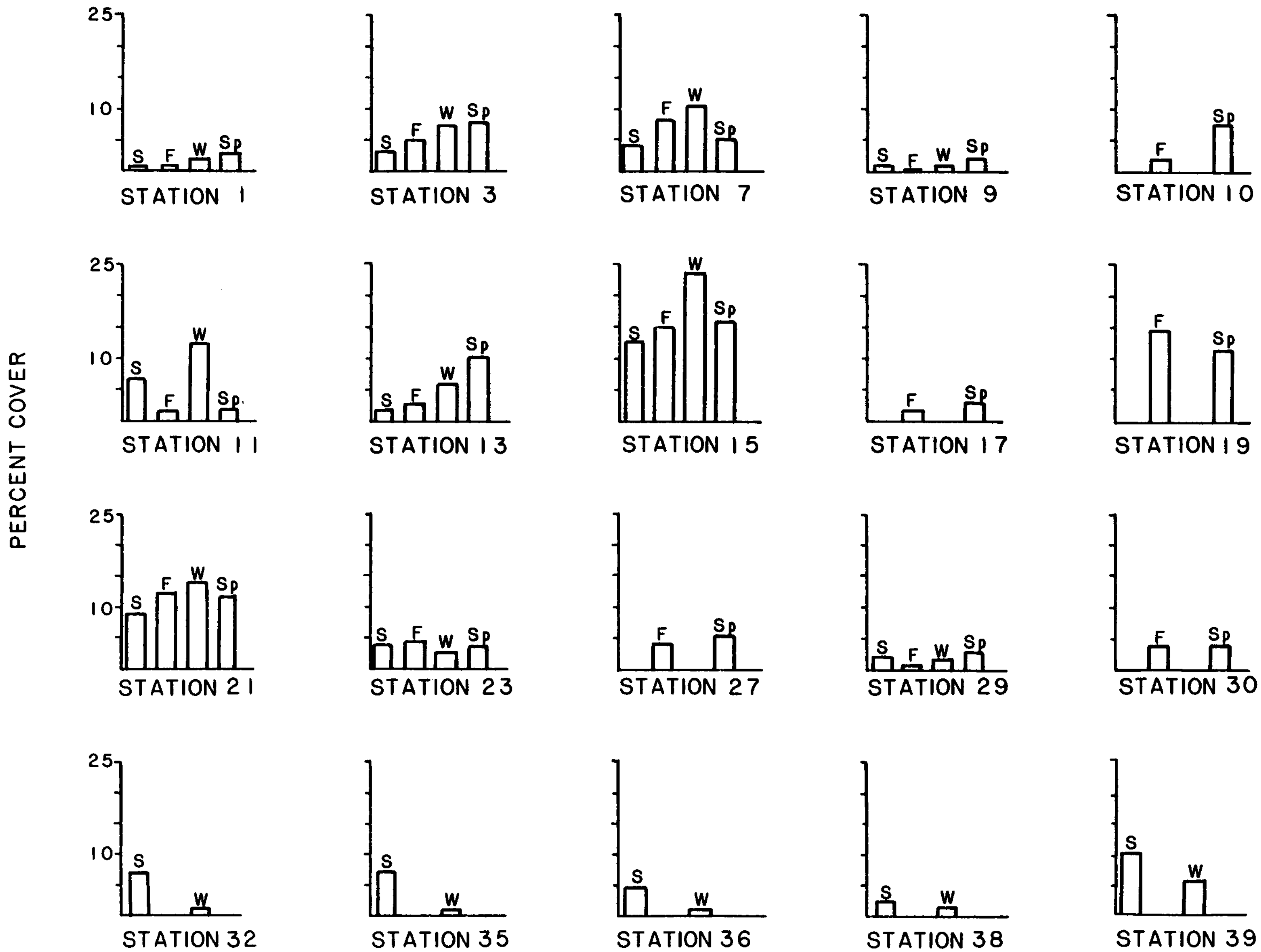


Figure 6-39. Seasonal variations in percent cover estimates for sponges (Porifera) at live bottom stations.

mate of true mean abundance). The number of replicates was only somewhat higher (49) at Station 36 on the Winter Cruise. A seasonal influx of crinoids is possible, but their growth rates are generally not high enough to produce such a pronounced difference in cover in only six months (C. Messing, University of Miami, personal communication). Total crinoids captured in dredges were higher in winter at both stations (333 vs. 59 at Station 32 and 242 vs. 158 at Station 36), but a similar pattern was not evident in the trawls. We suspect that sampling inadequacy is a contributing factor. Sampling inadequacy is also likely to at least partly explain the changes in gorgonian cover at Station 13; even though a large number of slides was examined (100), the gorgonians were so patchy that the estimate of their average contribution to total cover at the station is questionable. The problem of sampling adequacy is discussed further in Section 6.6.3.

6.5.4 Summary and Comparison with Other Studies

The preceding sections suggest that: 1) taxonomic richness varies seasonally among both algal and some non-algal taxa at most stations and the variation (at least for all taxa combined) is generally greater at shallow than mid shelf or deep outer shelf stations; 2) overall taxonomic composition, as judged from biotal zonation patterns derived from cluster analysis of dredge and trawl data, varies little seasonally despite changes in taxonomic richness (although problems in sampling adequacy and the effects of truncation of the data set complicate the results); and 3) biotal cover varies seasonally, primarily reflecting seasonal abundance patterns of different algal groups.

Epifaunal Seasonality -- Limited data are available for comparison, especially concerning epifauna. A similar large-scale study of live bottom habitats in the South Atlantic Bight [Marine Resources Research Institute (MRRI), 1982] found little seasonal variation in overall taxonomic richness or zonation patterns (algal taxonomic richness and cover, however, varied seasonally, especially at shallow, inshore stations). Other comprehensive data are available for crustaceans of the South Atlantic Bight, as summarized by Wenner and Read (1982). In that study, total numbers of species and individuals varied seasonally, reaching a maximum in summer or fall and a minimum in winter or spring; the abundance of dominants (most abundant taxa) also varied seasonally. As in the present study, major depth-related species groupings from cluster analysis varied little seasonally despite changes in abundance and taxonomic richness. In the Hourglass study area (which extended from midway between Transects A and B in the present study area north to 27°37'N latitude and encompassed depths ranging from 6 to 73m), monthly dredges and trawls were conducted at several stations (few were live bottom habitats, however) over a 28-month period (Lyons and Camp, 1982). However, the data have emerged in irregular reports concerning particular taxonomic groups [e.g., Cairns, 1977 (stony corals); Gore and Scotto, 1979 (parthenopid crabs); Serafy, 1979 (echinoids)], and no reports on sponges have yet appeared. The major synthesis of such data to date (Lyons and Camp, 1982) does not include information on (seasonal) frequency of occurrence. Catches for most taxa reported are spotty (as expected, because of the same sampling adequacy problems encountered in the present study), though for others, clear seasonal patterns in abundance are evident (e.g., the scyllarid lobster *Scyllarus chacei*, Lyons, 1970; the parthenopid crab *Parthenope agona*, Gore and Scotto, 1979). For other taxa, seasonality can be inferred from the age-class structure or reproductive condition of individuals collected (e.g., the stomatopod *Gonodactylus bredini*; Camp, 1973). A variety of epifaunal invertebrates can be expected to exhibit seasonal growth and reproduction patterns in response to seasonal variations in temperature and light levels.

Tropical sponge assemblages are nonseasonal; temporal variations are likely to result from periodic disturbance and competitive interactions with other epibiota (Jackson, 1977; Jackson and Winston, 1982). In more temperate locations, cover by sponges (especially encrusting forms) is often seasonal. Gallaway and Lewbel (1982) reported winter growth and summer dieback of sponges associated with nearshore petroleum production platforms in the northern Gulf of Mexico. Encrusting forms such as *Haliclona* sp. and *Microciona* sp. exhibit seasonal patterns in Hatteras Harbor, North Carolina (Wells et al., 1964). However, most of the larger sponges such as *Ircinia compana*, *Cinachyra alloclada*, and *Spheciospongia vesparium* can be expected to exhibit low growth rates (Reiswig, 1973). Many changes in estimated cover and taxonomic richness in the present study probably reflect patchiness of distribution that is not adequately overcome by the number of photographs taken on each survey (see Section 6.6.3). In addition, the possibility of periodic burial and reexposure could result in temporal cover changes; little is known of sediment mobility at our stations.

Algal Seasonality -- Considerable data concerning algal occurrence and seasonality on the west Florida shelf are available for comparison in the reports of Dawes and Van Breedveld (1969) for the Hourglass study area and Cheney and Dyer (1974) and Hopkins et al. (1977) for the Florida Middle Ground.

The data of Dawes and Van Breedveld (1969) consist of monthly records of presence/absence in dredge or trynet samples; a total of 157 species (38 chlorophytes, 29 phaeophytes, 85 rhodophytes, and 5 cyanophytes) were collected (compared with 149 total species collected in the present study, including 38 chlorophytes, 27 phaeophytes, 84 rhodophytes, and 2 cyanophytes). The shallowest Hourglass stations (in 6m depths; the shallowest station in the present study was at 20m) exhibited a species-poor, highly seasonal flora. Stations in 20 to 60m depth were characterized as having many species, including a large number of perennials (e.g., *Halimeda discoidea*, *Caulerpa sertularioides*, *Gracilaria mammillaris*). Stations at 70m depth were relatively species-poor but most species were perennials; reduced taxonomic richness was attributed to low light penetration. In the present study, algal species richness was also higher at the 20 to 60m stations than at the 70 to 80m stations (Stations 10, 11, 23, and 30), and most of the taxa found at the latter were also perennials (e.g., *Halimeda* spp., *Peyssonnelia rubra* and *P. simulans*, and *Anadyomene menziesii*). It is interesting to note, however, that the coralline algal nodule assemblage characteristic of Stations 10, 11, 23, and 30 in our study area was apparently not present at comparable depths in the Hourglass study area; red algae in the order Cryptonemiales, such as *Peyssonnelia rubra*, *P. simulans*, and the coralline algae *Lithothamnium* sp., and *Lithophyllum* sp. were generally not even collected at Hourglass Stations E and M (73m depths) (except for two occurrences of *Lithothamnium* sp.). Lyons (1970), however, noted that substrates at the 73m depth stations included coralline algal rubble as well as shell debris. Within our study area, the coralline algal assemblage appears less developed at the northern end (Stations 10 and 11) and was not present on Transect A (which overlaps with the Hourglass study area), perhaps explaining its absence in the Hourglass samples. Dawes and Van Breedveld (1969) observed that phaeophytes as a group were the most seasonal in their occurrence and described their annual cycle of abundance as involving a growth period in late spring to early summer, maturation during summer, and disappearance in early winter [a finding in accord with the winter disappearance of phaeophyte species at the Florida Middle Ground (Cheney and Dyer, 1974) and in the present study]. However, within our study area, phaeophyte cover was frequently maximal in spring, even though the highest species richness was generally found in summer. Also, despite the presence of numerous perennial species at inner and middle shelf stations in our study area, seasonality in terms of cover was high, with chlorophyte and rhodophyte cover frequently dominating in summer and fall.

Cheney and Dyer (1974) and Hopkins et al. (1977) have described the benthic algae of the Florida Middle Ground, an area of relatively high relief limestone outcrops in the northeastern Gulf. Hopkins et al. (1977) reported 103 algal species but did not provide a systematic breakdown; however, of 92 taxa reported by Cheney and Dyer (1974), 22 were chlorophytes, 9 phaeophytes, 53 rhodophytes, and 7 cyanophytes. Marked seasonal patterns of occurrence were noted by Cheney and Dyer (1974); all three major groups were represented by far fewer species (none in the case of phaeophytes) in winter than in summer. As noted by Dawes and Van Breedveld (1969), there were both seasonal and perennial components to the flora; Cheney and Dyer (1974) noted that perennials are usually crustose or creeping in habit and have well-developed holdfasts, citing (among others) *Halimeda discoidea*, *Udotea flabellum*, and *Peyssonnelia rubra*, all perennials that also occurred within the present study area. Hopkins et al. (1977) also observed that crustose red algae were present year-round whereas fleshy and/or filamentous rhodophytes were abundant during summer and/or fall--a pattern in accord with the general summer abundance (in photographs) of non-cryptonemialid rhodophytes at several of our inner and middle shelf stations.

Results of a large study of live bottom habitats in the South Atlantic Bight [Marine Resources Research Institute (MRRI), 1982] indicate far fewer algal species (45 off South Carolina and Georgia), few perennials, and marked seasonality of occurrence at shallow (16 to 25 m) inshore stations. Rhodophytes were the most seasonal in their occurrence, whereas phaeophytes including

Sargassum spp. were ubiquitous and relatively nonseasonal. Peckol (1982) examined reproductive seasonality of algae on the continental shelf of North Carolina and concluded similarly that many brown algae were perennials or pseudoperennials (overwintering in reduced form), whereas red algae were highly seasonal with reproductive activity peaking in summer. No mid shelf perennial algal assemblage was described in the MRRI study. However, CSA (1979) noted the presence of an assemblage characterized by the perennial red alga P. rubra and tube mats of the polychaete Phyllochaetopterus socialis at 50 to 85m depths on the shelf off South Carolina. Many of the deepwater (15 to 100m depths) algae off North and South Carolina are tropical forms that reach their northern limit of distribution off North Carolina (Searles and Schneider, 1980) and whose occurrence on the middle and outer shelf, as in the present study area, is favored by reduced temperature ranges at mid shelf depths and proximity of a shelf-edge current supplying a continual influx of Caribbean forms.

6.6 DISCUSSION

In the following sections, results are reviewed and discussed in relation to studies of other live bottom and reefal habitats on the outer continental shelf in the Gulf of Mexico and South Atlantic Bight. Potential effects of red tide and other sources of disturbance on live bottom communities are discussed. Finally, the approach and methodology are evaluated and recommendations are made for future studies. Environmental factors affecting zonation and seasonality of live bottom biota are evaluated in the context of the shelf as an ecosystem in Section 8.2.

6.6.1 Relationships to Other Reefal and Live Bottom Habitats

Relationships between faunal zones delineated in this study and those emerging from previous studies on the west Florida shelf have been discussed in Section 6.4.4, and comparisons of seasonal trends in epibiota have been presented in Section 6.5.4. This section provides a more general discussion of our results in the context of other hard bottom areas in the Gulf of Mexico and the South Atlantic Bight, followed by some specific biotal comparisons.

6.6.1.1 General Relationships

The development of true coral reef communities similar to those found in the Caribbean is limited in both the Gulf of Mexico and the South Atlantic Bight by substrate, temperature, salinity, and turbidity (Bright, 1983). Reefs generally develop in shallow, clear oceanic environments that experience relatively mild seasonal temperature variations and a minimum winter temperature of at least 18°C. However, tropical reefal communities have also developed at offshore locations such as the Florida Middle Ground (Hopkins et al., 1977) and the Flower Garden Banks (Bright and Pequegnat, 1974)--areas that, because of their high relief, extend into warm, oceanic near-surface waters. Even so, most such bank communities in the Gulf (with the exception of the Flower Garden Banks and portions of 18 Fathom Bank and Bright Bank) are characterized by a coralline algal-hydrozoan coral (*Millepora* sp.) biota rather than the fully developed hermatypic scleractinian coral communities of the Caribbean.

The East and West Flower Garden Banks, located off the Texas-Louisiana coast about 200 km southeast of Galveston, support well-developed *Diploria-Montastrea-Porites* coral reef communities at their crests at less than 50m depths; deeper (and more extensive) portions of these and several other shelf-edge banks in the northern Gulf of Mexico are characterized by extensive coralline algal assemblages that typically include leafy algae, sponges, and hard corals such as *Agaricia* sp. and *Madracis* sp. (Bright et al., 1983). This "Algal-Sponge Zone," which generally occurs at 50 to 85m depths on the Flower Garden Banks, resembles the assemblage noted at similar mid shelf depths in the southwest portion of the southwest Florida shelf (Station 29). The fringes of the Flower Garden Banks and other offshore banks in the northern Gulf, like the deeper locations on the southwest Florida shelf, are characterized by a sparse assemblage of antipatharians, comatulid crinoids, sponges, deepwater octocorals (shallow-water octocorals are not present at the Flower Garden Banks), and scattered coralline algae (Rezak and Bright, 1983). The lower depth extent of this "Antipatharian Zone" is limited in the northern Gulf by the ubiquitous near-bottom nepheloid layer, which does not occur on the outer southwest Florida shelf.

Other banks in the northern Gulf support biological assemblages similar to those observed at the Flower Garden Banks but lacking the extensive scleractinian hermatypic coral populations (Rezak and Bright, 1983). Hydrozoan (Millepora) coral communities dominate the crests of a few of these banks (e.g., Sonnier, Claypile, and Stetson banks). The major influences on the composition of these assemblages include temperature, turbidity, and salinity; the latter two are strongly related to proximity to the Mississippi River discharge. Inshore of the shelf-edge banks, scattered, low-relief hard bottom areas occur (Sonnier et al., 1976; CSA, 1982). These are enveloped in a dense nepheloid layer and support depauperate assemblages dominated by hydroids, bryozoans, ascidians, sponges, and a few ahermatypic stony corals (CSA, 1982). Farther east at the extreme northern margin of the Desoto Canyon, granular limestone outcroppings support a somewhat richer assemblage that includes a variety of tropical reef fishes (Shipp and Hopkins, 1978); localized turbidity appears to be responsible for patches of impoverished biota within the general area surveyed.

The Florida Middle Ground is an area of discontinuous carbonate outcroppings (23 to 40m depth) located in the northeastern Gulf west of Tarpon Springs, Florida. The hydrozoan coral Millepora sp. is believed to be the main framebuilder, although populations of hermatypic scleractinians (Porites, Dichocoenia, Madracis) are present at the upper depth ranges (26 to 30m) (Grimm and Hopkins, 1977). Shallow-water alcyonaceans (Muricea, Plexaura, Eunicea) are also present, and the fauna bears a distinct dissimilarity to that of the Flower Garden Banks (Hopkins et al., 1977). Although the Florida Middle Ground provides a high-relief substratum for reef biota, its location is apparently too far northward (winter temperatures can reach 15° to 16°C) to allow the establishment of massive hermatypic coral assemblages (Bright, 1983).

In addition to emergent natural hard bottom, substrate for establishment of hard bottom assemblages is provided by the presence of numerous offshore oil platforms in the northern Gulf of Mexico. The characteristics and ecology of platform associated biota have been summarized by Gallaway and Lewbel (1982). These communities exhibit characteristic inshore/offshore gradients in species composition, as well as marked vertical zonation patterns on particular platform legs. Gallaway and Lewbel (1982) divided platform associated biota of the northern Gulf into coastal (0 to 30m), offshore (30 to 60m), and bluewater (>60m) categories. Barnacles generally dominate cover on the upper levels of coastal platforms, with interspersed hydroids and algae; hydroids dominate deeper portions of the platform legs (George and Thomas, 1979; Gallaway and Lewbel, 1982). Bivalves generally replace barnacles as dominants on offshore platforms, and octocorals (Telesto) are also cited as indicative of this assemblage (Gallaway and Lewbel, 1982). Stalked barnacles (Lepas) and algal mats dominate upper levels of bluewater platforms, and hydroids and bivalves dominate at greater depths. Algae extend to greater depths in the clear water of the bluewater platform areas, and include some generally associated with deepwater banks, including Peyssonnelia spp. The most dramatic differences in assemblages associated with platforms are in the fish community, which is dominated by sheepshead and Atlantic spadefish, lookdown, gray triggerfish, etc., on coastal platforms; addition of red and grey snappers and a variety of tropicals at offshore platforms; and a highly diverse assemblage of tropicals at bluewater platforms.

The habitats most comparable to those studied here are found in the South Atlantic Bight rather than the Gulf of Mexico. The low-relief live bottom habitats of the South Atlantic Bight have been extensively studied. As on the southwest Florida shelf, the distribution of hard substrate (CSA, 1979; MRRI, 1982) is very patchy. MRRI (1982) conducted a biological survey of nine live bottom stations off Georgia, South Carolina, and North Carolina. These live bottom assemblages are dominated by sponges, algae, bryozoans, and a few hardy ahermatypic scleractinian corals. Although no habitats similar to the coralline algal nodule substrate or the Agaricia-coral plate substrate were noted in the MRRI study, CSA (1979) defined mid shelf assemblages on the South Carolina shelf that were characterized by abundant crustose red algae (Peyssonnelia rubra), which is generally typical of coralline algal nodule stations on the southwest Florida shelf. The total number of taxa collected by dredge and trawl sampling at six stations off South Carolina and Georgia over four seasons was 432 and 525, respectively (MRRI, 1982), significantly lower than the total number collected in this study (1,544 and 1,148, respectively); total catches at individual stations on each survey were also generally lower (200 or fewer taxa), despite the greater degree of replication in the MRRI study. As in the present study, consistent depth-related faunal zones were evident; however, no seasonal trends in epibiotal species richness or cover were observed except for algae at inshore stations. The hard bottom biota of the South Atlantic Bight have been characterized as a mix of tropical and warm-temperate (Carolinian) forms (MRRI, 1982; Wenner and Read, 1982; Wenner et al., 1983), similar to the mix noted in the present study. Although several of the visually conspicuous taxa noted in the MRRI study (e.g., the sponges *Ircinia campana*, *Spheciospongia vesparium*, and *Cinachyra alloclada*; the hard coral *Solenastrea hyades*) are also present on the southwest Florida shelf, the number of sponge and hard coral taxa was generally far lower at the stations in the South Atlantic Bight, and the taxa most frequently captured in dredges and trawls were generally hydroids and bryozoans rather than sponges and associated motile invertebrates. All of the crustacean taxa cited as commonly associated with rocky or reefal habitats (and 75 of the 100 most frequently captured crustaceans from all shelf habitats) in the South Atlantic Bight (Wenner and Read, 1982) are also present in our study area. Both areas are influenced by the presence of a strong tropical current at the shelf edge (the Loop Current and the Gulf Stream, respectively). These currents bring an infusion of tropical, Caribbean forms to each area. In addition, passage of major currents along the shelf edge generates upwelling of cold, deep, nutrient-rich waters onto the outer shelf. This upwelling could have important biological consequences, including: 1) restriction of the more shallow waters of the southwest Florida shelf are apparently unsuitable, whether due to occasional cold fronts, turbidity, sediment movement, etc., to allow the establishment of any extensive hermatypic coral populations on the inner shelf (see Section 8.2). The growth of coralline algae at mid shelf depths (60 to 80m), which results in the production of algal nodules and a crustose algal pavement in the southwest portion of the study area, provides an extensive emergent substrate for the development of deepwater hermatypic corals. The coral _Agaricia_ sp., with its platelike growth form, is adapted to maximize light capture at these depths, and the sharp lower depth limit of its occurrence in the study area (about 80m as noted in television transect surveys) suggests light limitation.

The coralline algal nodule and algal pavement/_Agaricia_ assemblages represent the nearest approach to the development of an active reefal habitat on the shelf. The remaining hard bottom areas scattered across the broad shelf, whether consisting of exposed or thinly covered hard bottom, are generally colonized by seasonal algae, sponges, and other filter feeders of mixed warm-temperature (Carolinean) and tropical (Caribbean) affinities. The tropical biota consists primarily of the hardier, more tolerant forms (Lyons, 1980) (including, for example, the hard corals _Siderastrea_ sp. and _Solenastrea_ sp). The biota of the northern and eastern Gulf of Mexico includes both tropical and Carolinian elements due to historic submergence of the Florida peninsula (Hedgpeth, 1953), although Bright (1983) has suggested that the general affinity of hard bottom biota in the northern Gulf with that in the South Atlantic Bight argues for contemporary genetic exchange.

6.6.1.2 Some Specific Faunal Comparisons

Corals -- Cairns (1978) has presented a checklist of all ahermatypic scleractinian corals found in the Gulf of Mexico. Of 37 species reported by Cairns as occurring in the eastern Gulf, 16 were collected during the present study. Most of those not collected in the present study are deep shelf/slope forms, although a few shallow shelf species (_Cladocora debilis_, _Astrangia astreiformis_, _Balanophyllia floridana_) were not collected even though they are present in the area (Lyons and Camp, 1982). Table 6-86 lists all scleractinian

Table 6-86. Comparison of scleractinian species collected in the present study with species lists from the Florida Middle Ground (Grimm and Hopkins, 1977) and the Hourglass study area (Lyons and Camp, 1982).

SPECIES	LOCATION		
	Florida Middle Ground	Hourglass Study Area	Southwest Florida Shelf (This Study)
Stephanocoenia michelinii	+	+	+
Madracis asperula		+	+
M. decactis	+	+	+
M. formosa			+
M. mirabilis			+
M. brueggemanni			+
Agaricia lamarcki			+
A. fragilis	+	+	+
A. fragilis contracta			+
A. fragilis fragilis			+
A. agaricites			+
A. agaricites agaricites			+
A. agaricites purpurea			+
Leptoseris (Helioseris) cucullata			+
S. radians	+	+	+
Porites porites			+
Porites porites divaricata	+	+	+
Porites astreoides			+
Porites branneri	+		+*
Favia gravida			+
Manicina areolata	+	+	+
Cladocora arbuscula	+	+	+
Cladocora debilis		+	
Solenastrea hyades		+	+
Montastrea cavernosa			+
Phyllangia americana	+	+	+
Astrangia solitaria			+
A. astreiformis		+	
Oculina diffusa	+		+
O. robusta		+	+
O. tenella		+	+
Meandrina meandrites			
Madrepora carolina			+
Dichocoenia stokesii	+		+
D. stellaris	+		+*
Scolymia lacera	+	+	+
S. cubensis	+		
Isophyllia multiflora			+

Table 6-86. Continued.

SPECIES	LOCATION Florida Middle Ground	Hourglass Study Area	Southwest Florida Shelf (This Study)
I. sinuosa		+	+
Mussa angulosa	+		+
Rhizosmilia maculata			+
Caryophyllia horologium			+
C. berteriana			+
C. maculata		+	
Oxysmilia rotundifolia			+
Paracyathus pulchellus			+
Coenosmilia arbuscula			+
Dasmosmilia lymani		+	
Deltocyathus calcar			+
Trochocyathus rawsonii			+
Anomocora fecunda			+
Flabellum fragile			+
Javania cailleti			+
Guynia annulata			+
Balanophyllia wellsi			+
B. floridana		+	
Dendrophyllia cornucopia			+

*Species collected in Year Three sampling only.

corals collected during this study and, for comparison, provides notations of species also present at the Florida Middle Ground (Grimm and Hopkins, 1977) and those collected during the Hourglass Cruises (Lyons and Camp, 1982), which encompassed an area north of the present stations but overlapping with our Transect A. The Hourglass Cruises stations were not selected to focus on hard bottom communities, and rock outcrops were most evident at stations in the 18 to 37m depth range (Lyons and Camp, 1982).

Although a much higher number of scleractinian species were collected in our study than was reported from the Florida Middle Ground (Grimm and Hopkins, 1976), our study encompassed a much larger area and a wide range of depths. A number of ahermatypes (e.g., Javania cailleti, Trochocyathus rawsonii, Caryophyllia berteriani, Coenosmilia arbuscula, Anomocora fecunda) are characteristic of deep shelf/upper slope waters (Cairns, 1977).

Among the more common hermatypic hard corals obtained during this study were Siderastrea radians, Scolymia lacera, Manicina areolata, Cladocora arbuscula, Solenastrea hyades, and Stephanocoenia michelinii. None formed any massive structures. Agaricia fragilis and A. agaricites formed extensive coral plate habitats at Station 29 but were limited to a few other scattered occurrences in the study area.

Several shallow-water gorgonians were also noted by Grimm and Hopkins (1977) as characteristic of the Florida Middle Ground, including Pseudopterogorgia acerosa, P. rigida, Lophogorgia cardinalis, L. hebes, Pterogorgia guadalupensis, Muricea elongata, M. laxa, Eunicea calyculata, E. knightii, Plexaurella fusifera, Plexaura flexuosa, and Pseudoplexaura wagenaari. All of these with the exception of Plexaura flexuosa and M. laxa were collected at our Station 13, the shallowest station (Table 6-87). Although some shallow-water gorgonians were present at other stations (e.g., Station 19), Station 13 was the only one with a large number of species and high overall gorgonian density. Year Three sampling has since revealed that extensive gorgonian-dominated assemblages also occur inshore of the 20m isobath. Smith (1976) reported high densities of gorgonians associated with patch reefs off west central Florida in less than 20m depths. Similarly, gorgonians (Plexauridae and Gorgoniidae) are highly

Table 6-87. Occurrence of gorgonian (Gorgonacea) species at shallow (20 to 40m depths) in the southwest Florida shelf study area and at the Florida Middle Ground (Grimm and Hopkins, 1977).

SPECIES	LOCATION (depth)					
	Station 13 (20m)	Station 19 (22m)	Station 1 (24m)	Station 7 (30m)	Station 15 (32m)	Florida Middle Ground (23-40m)
Diodogorgia nodulifera				+		+
Plexaura flexuosa						+
Pseudoplexaura porosa	+					
P. wagenaari	+					+
Eunicea calyculata	+					+
E. calyculata calyculata	+					
E. knighti	+					+
Plexaurella nutans	+					
P. fusifera	+					+
P. dichotoma	+					
Muricea elongata	+					+
*M. laxa**						+
Scleracis guadalupensis				+		
Lophogorgia cardinalis	+	+			+	+
L. hebes	+			+		+
L. barbadensis		+				
Pseudopterogorgia acerosa	+	+				+
P. rigida	+					+
Pterogorgia guadalupensis	+					+

**Muricea laxa* has since been collected at shallower stations during Year Three of this study.

abundant on shallow patch reefs off the east coast of Florida (Goldberg, 1973).

Fishes -- The west Florida shelf has long been recognized as an area that supports commerically important fish and shellfish populations, an importance that has been attributed at least in part to the abundance of scattered rock outcrops and "sponge bottom" (Darcy and Gutherz, 1984) that provide fish habitat. Commercially imporant species include black mullet (Mugil cephalus), spotted seatrout (Cynoscion nebulosus), Spanish mackerel (Scomberomorus maculata), king mackerel (S. cavalla), Florida pompano (Trachinotus carolinus), snappers (Lutjanus spp.), and grouper (Epinephelus spp., Mycteroperca spp.), several of which are primarily nearshore/estuarine inhabitants. The only species of commercially important fish frequently collected in trawls at live bottom stations was the red grouper, Epinephelus morio.

The most speciose families of demersal fishes on the shelf are the Bothidae (left-eye flounders), Serranidae (sea basses), Scianidae (drums), and Triglidae (sea robins) (Topp and Hoff, 1972; Smith, 1975; Darcy and Gutherz, 1984), and many of the more commonly collected fishes on the shelf as a whole [e.g., Syacium papillosum (dusky flounder), Diplectrum formosum (sand perch), Centropristis ocyurus (bank sea bass), Bothus robinsi (twospot flounder), Prionotus spp. (sea robins)] belong to these families. Families represented by the largest number of species in the present study are Serranidae (22), Apogonidae (13), Bothidae (12), Triglidae (12), and Scorpaenidae (12).

Table 6-88 shows the station occurrences (ordered by depth) of the 10 most frequently collected demersal fishes from live bottom stations. Monacanthus ciliatus and Syacium papillosum were the most ubiquitously distributed, though even these were infrequently caught at the deep (120 to 160m) stations. According to Topp and Hoff (1972), S. papillosum is common at most depths (at least out to 73m) beyond 18m within the Hourglass study area; the species was also more abundant in the 36 to 93m depth range than in the 9 to 35m depth range in the trawl collections reported by Darcy and Gutherz (1984) from the southwest Florida shelf. Also, as in the latter study, we found S. foetens to be more common in relatively shallow water (20 to 40m). Topp and Hoff also

Table 6-88. Summary of station occurrences of the 10 most frequently captured fishes from live bottom stations.

SPECIES	STATIONS																		
	Depth Range																		
	20 to 40m					40 to 60m					60 to 80m					120 to 160m			
	13	19	1	7	15	21	3	27	9	17	29	23	10	30	11	36	32	35	38
<u>Monacanthus ciliatus</u> (fringed filefish)	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+			-	
<u>Synodus intermedius</u> (sand diver)	-	-	-	+	+	+	+	+	+	+		+		+			-		-
<u>Serranus phoebe</u> (tattler)		-				+	+	+	+	+		+	+	-	+				-
<u>Synodus poeyi</u> (offshore lizardfish)		-		+	-		+	+	+	+		+	+		+	+	-		
<u>Syacium papillosum</u> (dusky flounder)	+	+	-	-	+	+	+	+	+	+			-		-	-			
<u>Hippocampus erectus</u> (lined seahorse)	+	-	+	+			-	-	+	+		+	+		+				
<u>Serranus notospilus</u> (saddle bass)	-			-			+		+	+		+	+	-	-	-	-	-	+
<u>Rypticus bistrispinus</u> (freckled soapfish)	-			+	+	-	-	-	+			+	+	-	-	+			
<u>Halieutichthys aculeatus</u> (pancake batfish)							+	+	+	-		-	+		+	+	-	-	
<u>Synodus foetens</u> (inshore lizardfish)	-	+	+	+	+		+		+										

Species are listed in order of overall frequency of occurrence. A '+' indicates occurrence in more than one trawl at a station; '-' indicates one trawl occurrence.

noted that the twospot flounder (Bothus robinsi) (not cited in Table 6-88 but among the 20 most frequently collected fishes) was restricted to stations in 18 to 55m depths within the Hourglass study area; in our results, the species occurred at all stations in 20 to 54m depths, with only one occurrence at a deeper station (Station 11, 77m depth) was noted.

Ross (1983) has reviewed data concerning searobins (Triglidae) from the Hourglass Cruises and other collections from Tampa Harbor. Of the eight common species cited in those collections, two were limited primarily to depths shallower that those sampled in the present study. Of the remaining six species (Prionotus alatus, P. martis, P. ophryas, P. roseus, P. salmonicolor, and Bellator militaris), all but P. salmonicolor were collected in trawl samples during the present study. P. roseus was by far the most frequently collected and was the only searobin among the 20 most frequently collected fishes. This species feeds primarily on natantian crustaceans (e.g., Leptochela) and exhibits a distinct diel feeding pattern with feeding activity concentrated between sunrise and noon (Ross, 1983). Its range of occurrence in the present study (20 to 58m depths, but generally more frequently captured at the deeper end of this range) is similar to that reported by Ross (1983) for the Hourglass study area. Among the other searobin species collected in our study, P. alatus was common only at mid shelf stations (9, 10, 11), whereas B. militaris and P. stearnsi were collected at middle and outer shelf stations. As in the Hourglass collections, B. brachychir and B. egretta were rare; the latter was collected only at deep outer shelf stations (32, 36).

Fish trawling during the Mississippi-Alabama-Florida (MAFLA) baseline survey, which covered an area extending from within the Southwest Florida Shelf Study area to the coasts of Mississippi and Alabama, showed some characteristic associations of fish species (Shipp and Bortone, 1979). A sand bottom assemblage typified by Syacium papillosum (dusky flounder), Synodus intermedius (sand diver), Centropristis ocyurus (bank sea bass), and Sphoeroides dorsalis (marbled puffer) was widely distributed and characteristic of the entire study area. Similarly, most of the fishes cited by Darcy and Gutherz (1984) as having the highest frequency of occurrence in trawl samples on the west Florida shelf, including Diplectrum formosum (sand perch), Syacium papillosum (dusky flounder), Monacanthus hispidus (planehead filefish), Lactophrys quadricornis (scrawled cowfish), and Centropristus ocyurus (bank sea bass), are not specifically or primarily associated with hard bottom habitats, although several exhibit preference for calcareous sediments. All of the fishes listed above were common in our study. Using Starck's (1968) distinction between "primary" (occurring primarily on reefs) and "secondary" (occurring on reefs but equally or more characteristic of other habitats) reef species as applied by Smith (1976), nearly all of the most commonly captured fishes in our study would be classified as secondary reef species as evidenced, for example, by the occurrence of many of the same species at soft bottom stations in this study (see Section 7.0). Station 29, as one might expect, supported a fish assemblage that was more tropical-reefal in character, including a variety of butterflyfishes (Chaetodontidae), damselfishes (Pomacentridae), cardinalfishes (Apogonidae), and a few wrasses (Labridae). Small, cryptic reef species are likely to have been seriously undersampled using the trawls (Powles and Barans, 1980).

Penaeid Shrimps -- Penaeid crustaceans of commercial value occur within or near the study area, including the pink shrimp, Penaeus duorarum, and the rock shrimp, Sicyonia brevirostris. Other penaeids commonly encountered on the west Florida shelf include Metapenaeopsis goodei, Trachypenaeus constrictus, Mesopenaeus tropicalis, Sicyonia typica, S. stimpsoni, S. burkenroadi, and Solenocera atlantidis (Huff and Cobb, 1979). All are generalized carnivores, feeding on benthic crustaceans, bivalves, and polychaetes (Kennedy et al., 1977; Huff and Cobb, 1979) and several exhibit preferences for calcareous substrates (Williams, 1958; Huff and Cobb, 1979). P. duorarum is generally associated with fine sediments that predominate in the southeastern portion of the study area (Tortugas pink shrimp grounds) and with inshore areas (10 to 20m depths) near Sanibel Island (Sanibel grounds) (Costello and Allen, 1965) and was not collected at any live bottom stations, although it was collected in trawls at some soft bottom stations.

Table 6-89 lists the depth range and depth of most frequent occurrence for penaeids collected at live bottom stations, based on both trawl and dredge sampling. Sicyonia brevirostris was most common at stations in the 50 to 60m

Table 6-89. Depth range of occurrence for frequently collected penaeid crustaceans from live bottom stations, based on trawl and dredge data.

SPECIES	Depth Range of Station Occurrences	Depth Range(s) of Most Frequent Occurrence
Sicyonia brevirostris	20 to 77m	40 to 60m
S. typica	20 to 32m	20 to 40m
S. stimpsoni	56 to 159m	120 to 160m, 60 to 80m
Solenocera atlantidis	30 to 77m	40 to 60m
Metapenaeopsis goodei	20 to 77m	20 to 40m, 40 to 60m
Trachypenaeus constrictus	20 to 71m	20 to 40m
Mesopenaeus tropicalis	44 to 159m	120 to 160m

Depth ranges of live bottom stations:

20 to 40m: Stations 1, 7, 13, 15, 19
40 to 60m: Stations 3, 9, 17, 21, 27
60 to 80m: Stations 10, 11, 23, 29, 30
120 to 160m: Stations 32, 35, 36, 38

depth range; Kennedy et al. (1977) reported maximum abundances in the 34 to 55m depth range off Florida's east coast and Huff and Cobb (1979) reported most common abundances at their 37m stations within the Hourglass study area. Similarly, Darcy and Gutherz (1984) reported maximal catches of the rock shrimp in approximately 40 to 50m depths on the central west Florida shelf. Most of the other results are in good agreement with previous findings from the Hourglass Study, which encompassed fewer stations and depths (Huff and Cobb, 1979). Generally, *Sicyonia typica* and *T. constrictus* were restricted to shallow shelf waters; *Metapenaeopsis goodei* also occurred inshore but extended farther offshore to mid shelf depths; *S. brevirostris* and *Solenocera atlantidis* were commonly restricted to mid shelf depths, and *S. stimpsoni* and *Mesopenaeus tropicalis* were more characteristic of outer shelf stations. Bathymetric zonation presumably reduces competition among these ecologically similar species. Subtle differences in substrate preference, diet, and reproductive periodicity also contribute to their ecological separation (Huff and Cobb, 1979).

6.6.2 Apparent Health of Live Bottom Communities in Relation to Red Tides and Other Possible Sources of Disturbance

Blooms of potentially toxic dinoflagellates (e.g., *Ptychodiscus brevis*) occur frequently (possibly annually) in the open waters of the eastern Gulf of Mexico (Steidinger and Ingle, 1972), occasionally leading to major inshore outbreaks of "red tide" typified by major fish kills (Smith, 1979; Steidinger and Haddad, 1981). The initiation of these blooms requires a "seed" population, presumably of benthic resting stages of the dinoflagellates involved (Steidinger, 1975). Although the exact causal relationships have not been elucidated, red tide outbreaks can be linked to intrusions of Loop Current water onto the shelf (Steidinger and Haddad, 1981). Aside from the fish kills, these toxic blooms can result in accumulations of neurotoxins in suspension feeders, which may concentrate the toxins without detrimental effects on themselves and pass them on to consumers (including humans). Additionally, large blooms have the potential for depleting benthic oxygen levels as they eventually die out. Thus, the occurrence of red tides has the potential for serious effects on live bottom communities of the southwest Florida shelf. The existence of such potential agents of major change in communities (Smith, 1975, 1979) must be kept in mind as a potential confounding factor in any attempt to detect effects of oil and gas activities in the area.

No direct evidence is available to evaluate the apparent effects (or lack thereof) of red tides on live bottom communities, because this study was not designed to detect such changes. In order to do so, one would have to establish baseline and post-impact data in an area of likely impact (or fortuitously have such data on hand) and in a control area not exposed to the impact (Green, 1979). However, a major, extensive outbreak occurred in late 1979 - early 1980 (Steidinger and Haddad, 1981), and circumstantial evidence suggests that no major, lasting effects of red tides have occurred. First, no direct evidence of major fish or invertebrate mortality was observed on any of the cruises. Second, the general lack of between-cruise variation in depth-related trends in taxonomic composition (e.g., triangle dredge data) is not consistent with community recovery patterns one might expect to see following a disturbance (e.g., Smith, 1975, 1979). Although a large bloom of blue-green algae (often the first colonists of a disturbed habitat) was observed at Station 13 on the Summer Cruise, the algal cover did not replace existing gorgonian and sponge cover (both were high on the following cruise) and the results do not suggest that a catastrophic disturbance occurred.

A potentially useful indicator of communities recovering from catastrophic disturbance is the predominance of opportunistic species uncharacteristic of the particular environment; such disturbance-related changes in community composition have been described for reef fish communities (Smith, 1979), reef invertebrate communities in general (Pearson, 1981), and soft bottom infaunal communities (Boesch and Rosenberg, 1981). In a study of effects of red tide on shallow (12 to 18m) reef fish communities of the west Florida shelf, Smith (1979) noted that devastated reefs were initially colonized by species characteristic of deeper waters that were eventually replaced by those characteristic of shallow waters. We do not believe the present type of data (i.e., from unreplicated trawls) on fish populations provides an adequate picture of the composition of resident fish communities at these live bottom stations. Diver censuses or other visual (e.g., from a submersible) fish population estimates in conjunction with trawl sampling would provide a sound basis against which to assess any red-tide effects. In regard to invertebrate assemblages, in the absence of clear, immediate evidence for catastrophic mortalities, it may be difficult to evaluate the status of a community as "disturbed" or "normal," especially considering that the communities have not historically been well studied. The present study helps to provide a general baseline against which to evaluate future disturbances. Specific, intensive, and frequent pre- and post-disturbance sampling would have to be conducted to assure detection of anything other than prolonged catastrophic disturbance.

Potential effects of red tides must also be considered in the context of other possible chronic sources of disturbance. Shifting sediments at some (especially low-relief) hard bottom stations could possibly serve to maintain communities at some intermediate successional stage--for example, allowing rapid colonizers such as encrusting bryozoans to predominate over sponges, which generally are better competitors for space (Jackson and Winston, 1982). Hurricanes (Woodley et al., 1981) and other storm fronts (Bullock and Smith, 1979) clearly have the potential for damaging epibiotal communities, even at mid shelf depths. Severe, episodic predation (e.g., by Acanthaster on Pacific coral reefs) is another possible source of disturbance for live bottom communities. It may be difficult, in the absence of specific data showing direct effects of red tides, to separate long-term effects from results of these other potential sources of disturbance in the system.

Red tides pose problems for potential monitoring efforts at sites of oil and gas exploration/development. The confounding effects of red tides in such studies can be minimized if careful documentation of the extent and severity of blooms is obtained and if adequate control stations can be maintained.

6.6.3 Methodology Evaluation

Several aspects of the methodology employed in this study can be evaluated in the context of the overall objectives of the sampling program, which were largely descriptive in emphasis (see Section 1.0).

6.6.3.1 Overall Approach and Sampling Frequency

The general approach was to identify sites for stations from the television transects, then conduct sampling at these stations on four "seasonal" cruises. As reviewed in Section 2.0, we were able to identify broad zones of live bottom assemblages from television transects and to select stations representative of those zones. The general overall similarity of biotal zonation based on both remote photographic and station-specific collection methods suggests that the station selection process was satisfactory. One reservation can be expressed concerning the temporal spacing of cruises. Although sampling was conducted during four "seasons," these were necessarily spread out over about 16 months and only the Spring and Summer Cruises actually occurred in seasonal sequence. Use of data from these cruises to assess "seasonal" patterns necessarily assumes a year-to-year consistency of pattern that may not be justified. However, our results were able to identify plausible seasonal trends in taxonomic richness and epibiotal cover, suggesting that the temporal spacing of cruises was adequate.

6.6.3.2 Sampling Methods

The major methods used to assess or describe live bottom stations were: 1) Remote 35-mm color still camera photography coupled with quantitative slide analysis (QSA). This approach was intended to provide quantitative estimates of cover by various groups and by all epibiota and to yield a qualitative description of each station's benthic environment. 2) Dredge and trawl sampling to provide presence/absence data on epibiotal community composition and to provide specimens to aid in photographic identification of biota. The two types of gear were intended to sample slightly different components of the biota, with trawls providing better assessments of fishes, swimming crustaceans (e.g., shrimps), and some of the larger sponges that were either too large to fit in the dredge opening or were too patchy to be encountered by dredges, which encompass a smaller area than trawls.

Photographic Analyses -- Remote photography was very useful in providing the data for which it was intended. The major limitations of this approach in quantifying epibiota are: 1) the equation of cover with relative abundance, which provides a somewhat misleading description of community composition--organisms of differing shape and degree of erectness (e.g., gorgonians vs. encrusting bryozoans) may constitute the same degree of cover with widely differing levels of biomass, and some organisms may tend to overgrow or obscure underlying biota in photographs, biasing estimates of true community composition; and 2) the relative lack of taxonomic resolution--far fewer taxa were identifiable to the genus or species level with this technique than with dredges or trawls. As discussed below (Taxonomic Adequacy), the lack of taxonomic resolution in QSA data for some groups and especially at the deeper stations was a major limitation in the interpretation of the results. Detection of changes in community composition and assessment of overall similarity of epibiota at live bottom stations depends on an ability to identify (at least) the most abundant organisms.

<u>Dredges and Trawls</u> -- Dredge and trawl sampling provided a large number of taxa that were used to characterize community composition and to aid in the identification of biota from photographs. Major problems in the usefulness of dredge and trawl data derive primarily from differences in sampling adequacy (see the following section). Trawls did provide a better assessment of fish taxa present; 203 of 235 (or 85%) total fish taxa collected were captured in trawls (vs. 144 in dredges). In all other taxonomic groups, dredges captured by far the higher percentage of total taxa. We suspect that trawl sampling misses many of the smaller, cryptic, and tropical fishes, which would be more appropriately assessed using visual techniques (Shipp, 1982; Parker and Richards, 1984); this problem is being addressed by diver censuses in Year Three sampling at stations accessible to divers and in ongoing Years Four and Five sampling by remote videocamera assessments of fish populations.

Powles and Barans (1980) have shown that trawling alone often provides an inadequate assessment of fish communities at live bottom stations; baited traps and visual (diver-held television system) estimates were used to improve the overall description of fish assemblages off the southeast coast of the United States. Visual estimation is a commonly used approach in shallow reef environments accessible to divers (Sale and Sharp, 1983), and visual fish assessments from submersibles (e.g., Shipp, 1982; Parker and Richards, 1984) may hold the best potential for more complete descriptions of the ichthyofauna associated with deep reefal or live bottom environments.

6.6.3.3 Taxonomic Adequacy

A large number of species (about twice the number initially anticipated) were collected in the course of this study, many of them new records or previously undescribed species. The vast majority (95%) of specimens collected were identified to either the genus or (usually) species level. As shown in Table 6-90, most of the specimens not identifiable to genus or species were sponges, many of which were identified only to family or order. As Table 6-91 indicates, the problem was much more serious at the deep, outer shelf stations where many specimens were of previously undescribed or unknown taxa. Problems in the taxonomy of these sponges are unlikely to be resolved in the near future.

The lack of taxonomic resolution for some groups was the most serious limitation in the use of photographic data analyzed by QSA. Table 6-92 lists the percentage of total biotal cover that was identifiable to genus or species level at each station for each cruise. Most values were, in general, 50% or greater, but consistently low values were obtained at the deep Stations 32, 35, 36, 38, and 39, and values were also relatively low at Station 11. A low proportion of sponge cover at mid to outer shelf stations was identifiable to genus or species (Table 6-93). Also, crinoids and seasonal green algae at deep outer shelf stations were generally not identified from photographs. Two other trends are apparent. The first is that Year Two results (Summer and Winter Cruises) were generally better than Year One results (Fall and Spring Cruises); that is, more taxa were identified to a lower taxonomic level during Year Two. This simply reflects increasing familiarity of persons examining the slides with specific taxa present, a familiarity that was based on the identification of the specimens collected in dredges and trawls. Many species of sponges were photographed on deck immediately after collection, which not only aided in identification by taxonomists but allowed increasing numbers of species to then be identified from photographs later. Slides from the Year One cruises were

Table 6-90. Percentage of total taxa collected by triangle dredge that were not identified to genus or species.

Group	Total Number of Taxa Collected	Number Not Identified to Genus or Species	Percent Not Identified to Genus or Species
Algae (eukaryotic)	154	5	3.2
Porifera	288	47	16.3
Cnidaria	157	4	2.6
Mollusca	284	4	1.4
Crustacea	254	5	2.0
Ectoprocta	63	1	1.6
Echinodermata	123	7	5.7
Urochordata	55	5	9.1
Fishes	146	2	1.4

Table 6-91. Percentage of sponge taxa from dredge samples that were not identified to genus or species at selected stations.

Station	Depth (m)	Total Number of Sponge Taxa Collected	Number of Taxa Not Identified to Genus or Species	Percent of Taxa Not Identified to Genus or Species
11	77	97	16	16.5
15	32	114	11	9.6
19	20	38	2	5.3
21	44	142	19	13.4
32	137	40	10	25.0
35	159	28	8	28.6
36	127	30	7	23.3
38	159	39	11	28.2

Table 6-92. Percent of total biotic cover that was identifiable to genus or species from photographs.

Station	Cruise			
	Summer	Fall	Winter	Spring
1	51	9	84	13
3	56	61	78	24
7	50	32	86	12
9	48	64	72	30
10	-	40	-	32
11	21	23	10	55
13	5	24	25	16
15	38	68	84	55
17	-	48	-	18
19	-	64	-	78
21	15	32	54	39
23	32	58	80	72
27	-	32	-	50
29	67	86	82	78
30	-	49	-	44
32	1	-	2	-
35	2	-	22	-
36	7	-	4	-
38	2	-	2	-
39	<1	-	1	-

Table 6-93. Percent of total sponge cover that was identifiable to genus or species from photographs, Winter Cruise.

Station	Total Sponge Cover (%)	Percent of Total that was Identified to Genus or Species
1	2.00	87
3	7.45	76
7	10.54	86
9	0.53	34
11	12.34	<1
13	5.94	74
15	23.37	86
21	13.86	76
23	2.80	10
29	2.24	20
32	0.35	51
35	0.17	0
36	0.63	0
38	1.29	8
39	5.36	3

initially analyzed for the Year One report, and a complete repeat of these analyses was not considered feasible for the present report. A second trend in Table 6-92 is that Summer Cruise results were generally lower than those for the Winter Cruise. This generally reflects the higher proportional abundance of seasonal algae, which were often not identifiable to genus or species, during the Summer Cruise.

Most sponge cover noted in photographs from inshore stations could be identified to genus or species level (Table 6-93). However, taxonomic resolution was poor for the middle and outer shelf stations. Many of the sponges collected at these stations were previously undescribed or unknown deepwater forms that frequently could not even be identified from actual specimens.

Algae constituted the other major contributor to total cover, and the degree of taxonomic resolution varied widely (Table 6-94). Certain algae were readily identifiable from photographs: Anadyomene menziesii, Peyssonnelia spp., Sargassum spp., Gracilaria spp., Caulerpa spp., Udotea spp., Halimeda sp., etc. Where these algae contributed most of the cover, photographic analysis was adequate in characterizing the algal community. The high taxonomic resolution for Phaeophycophyta in Table 6-94 is not indicative of a general trend; during spring at several stations that exhibited high phaeophyte abundance, most were generally not identified to genus or species.

Photographic identification of biota to the level of genus or species, while straightforward for many species with distinctive characteristics, is impossible for some others that require a physical specimen for definitive identification. We have found that photographic identification of biota occupying most of the visible space on hard bottoms is possible; at most stations (with the exception of the very deepest ones studied here), a useful quantitative description of the epibiotal community can be achieved. Nevertheless, there is a "learning curve" to this approach, and routine use of quantitative slide analysis to characterize live bottom assemblages presupposes a thorough familiarity, based on collected specimens as well as photographs, with the common epibiota.

Table 6-94. Percent of total algal cover that was identifiable to genus or species level from photographs, Summer Cruise.

Station	ALGAL GROUP: Chlorophycophyta — Total Percent Cover	Chlorophycophyta — Percent of Cover Identified to Genus or Species	Rhodophycophyta — Total Percent Cover	Rhodophycophyta — Percent of Cover Identified to Genus or Species	Phaeophycophyta — Total Percent Cover	Phaeophycophyta — Percent of Cover Identified to Genus or Species
1	9.78	12	13.77	11	1.93	92
3	4.35	51	3.60	32	0.61	100
7	2.28	9	2.72	47	2.69	100
9	8.65	55	3.59	53	0.55	100
11	14.37	1	9.00	60	0.66	100
13	6.79	9	2.53	45	0.00	-
15	18.49	4	13.99	59	1.97	100
21	17.73	12	27.23	3	0.70	100
23	20.20	39	40.45	28	3.00	100
29	42.29	81	36.82	47	0.37	100
32	0.20	0	0.00	0	0.00	0
35	11.65	0	0.73	0	0.08	100
36	0.00	0	0.07	0	0.00	0
38	10.15	0	0.18	0	0.00	0
39	44.29	0	0.00	0	0.00	0

6.6.3.4 Sampling Adequacy

Each technique used to assess live bottom communities could in practice sample only a small proportion of the total area at a given station. Therefore, confidence in characterization of live bottom assemblages and their seasonal (or other) variations depends on the adequacy of the number of samples obtained. The pertinent questions are: 1) Were enough samples collected to assure that most or all of the distinct taxa were encountered? This can be addressed by examining species-saturation curves for dredge, trawl, and photographic samples. 2) Were enough samples collected to assure that precise estimates of relative abundance were obtained? This question applies only to photographic data and can be addressed by calculating confidence intervals for mean cover estimates for total epibiota and/or particular groups. 3) Were enough samples obtained to average over patchiness in relative abundance and provide an accurate estimate of mean cover for total epibiota and/or particular groups? This question, which also applies only to photographic data, can be addressed by plotting the estimated mean cover as a function of the number of replicates examined.

Triangle Dredge Data -- Figure 6-40 shows taxa-saturation curves for triangle dredge taxa at Stations 1 and 3 (which had a large number of taxa) and Stations 23 and 29 (which had a low number of taxa). The curves were generated by averaging all possible combinations of replicates. None of the curves approach an asymptote; therefore, three replicate dredges were insufficient to obtain most taxa at a station during a given sampling period. This conclusion is supported by the observation that, at most stations, the number of taxa collected on a given cruise was generally less than half (about 45%) of the total number collected on all four cruises combined.

Otter Trawl Data -- No species-saturation curves can be generated for otter trawl data, because only one trawl was obtained at each station during each cruise. At most stations, the number of taxa collected on a given cruise was generally less than 40% of the total number collected on all four cruises combined. Trawls nearly always collected far fewer species than did the (three replicate) dredges, even though 80% of the trawl-collected taxa were also col-

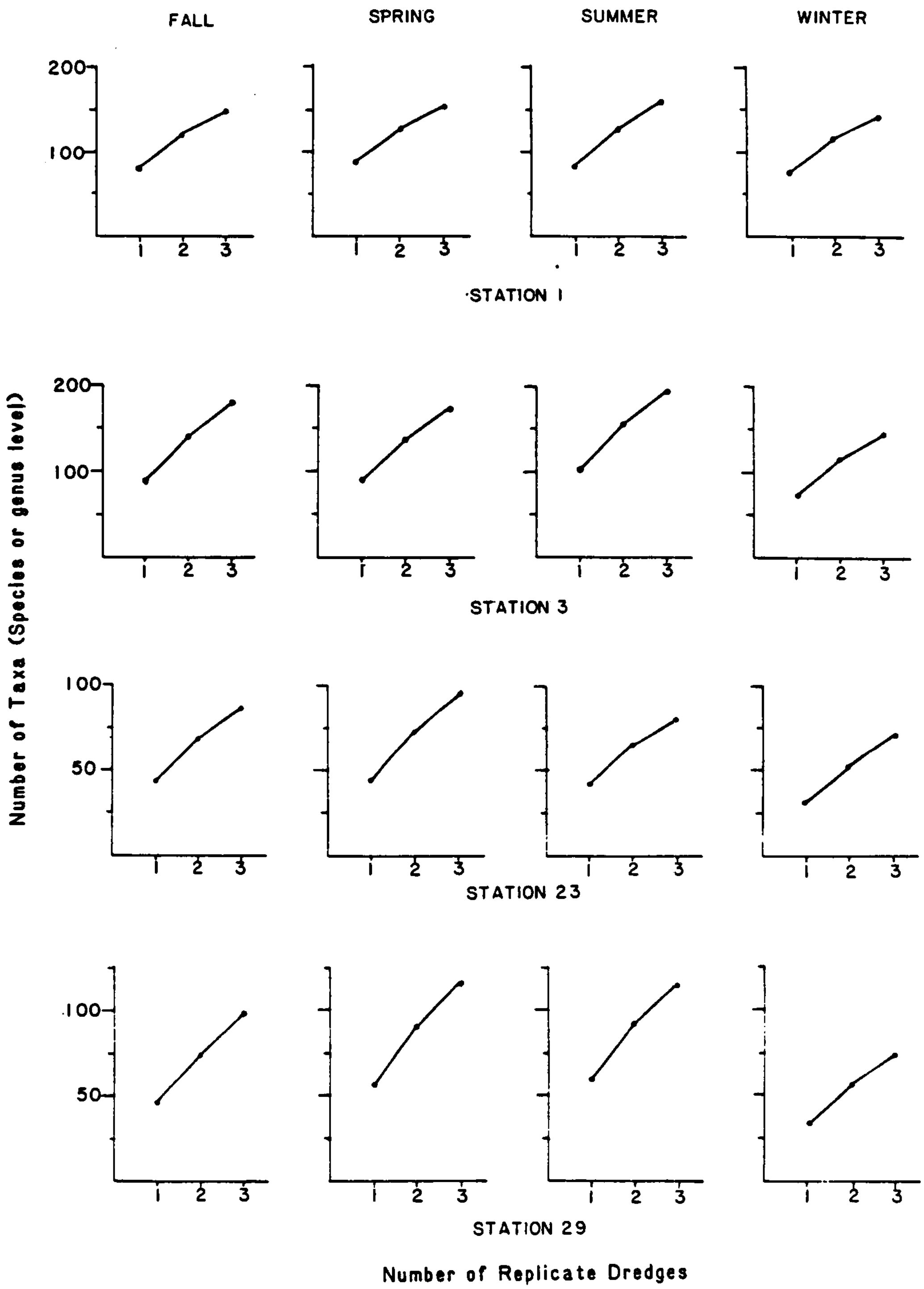


Figure 6-40. Taxa-saturation curves from triangle dredge data from Stations 1, 3, 23, and 29. Dredge replicates were ordered arbitrarily for the calculations.

lected in dredges. In other words, even though trawls collected largely the same suite of taxa (with the most obvious exception of fishes) as dredges, the trawls collected fewer of the total taxa present. These results suggest a greater sampling adequacy problem in trawls than dredges.

Quantitative Slide Analysis Data -- Taxa-saturation was nearly always obtained after examination of about 70 slides (Figures 6-41, 6-42) because few taxa were generally identifiable to genus or species level in any given slide. Therefore, the number of slides was nearly always sufficient to encounter all identifiable distinct taxa. The increased level of taxonomic resolution in Year Two slide analysis is also evident in these figures--the number of taxa identified during Year Two (Summer and Winter Cruises) was generally higher than the number identified during Year One. Table 6-95 lists the total biotic cover values, their associated standard errors, the 95% confidence limits for mean cover, and the 95% confidence range as a percent of the mean for each station on each cruise. The ability of the photographic technique to detect a given proportional change in percent cover is clearly related to both the number of slides examined and the average epibiotal cover present. For nearly all surveys in which 100 slides were examined, a 30% (proportional) change in percent cover would be detectable even at stations having low mean cover values (based on the overlap of 95% confidence limits). In the present study, this degree of confidence was sufficient to allow detection of plausible seasonal changes in total cover. In any future use of the approach in the study area (or in similar habitats), the number of replicate slides that must be analyzed to ensure detection of a predetermined level of change in cover could be calculated using methods provided by Sokal and Rohlf (1969). Attaining the same degree of confidence in estimates of coverage by particular taxa at a station is likely to require more replicates than needed to simply estimate total biotic cover with precision because the spatial distribution of individual taxa is likely to be both lower in magnitude and higher in patchiness than is total biotic cover. Table 6-96 shows some examples representing the extremes of both cover and patchiness for a few selected taxa. Again, any future sampling effort could be scaled to the required number of replicate slides if the abundance of a particular species were of concern.

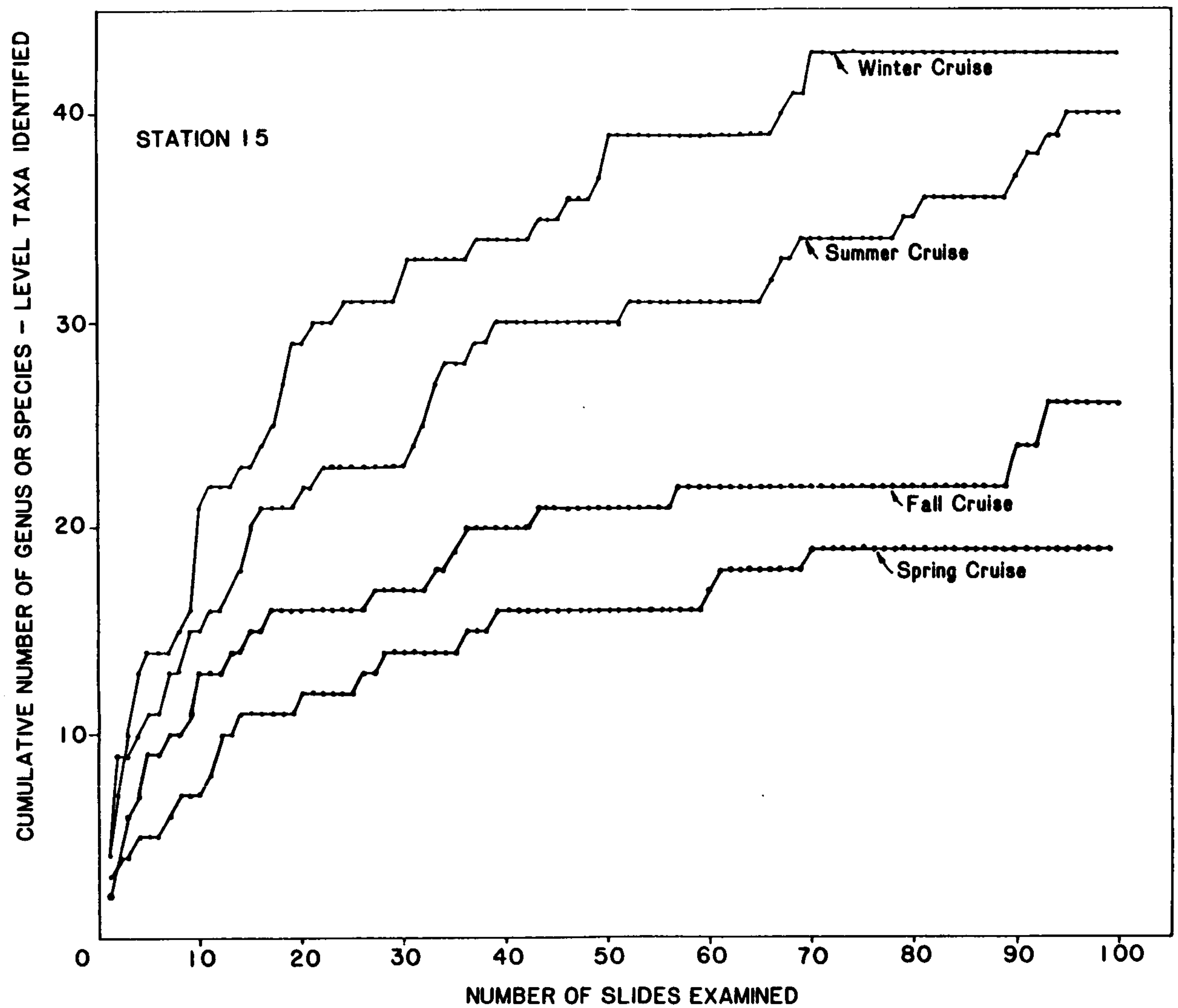


Figure 6-41. Taxa saturation curves for photographic data from Station 15. Only genus or species level taxa are included.

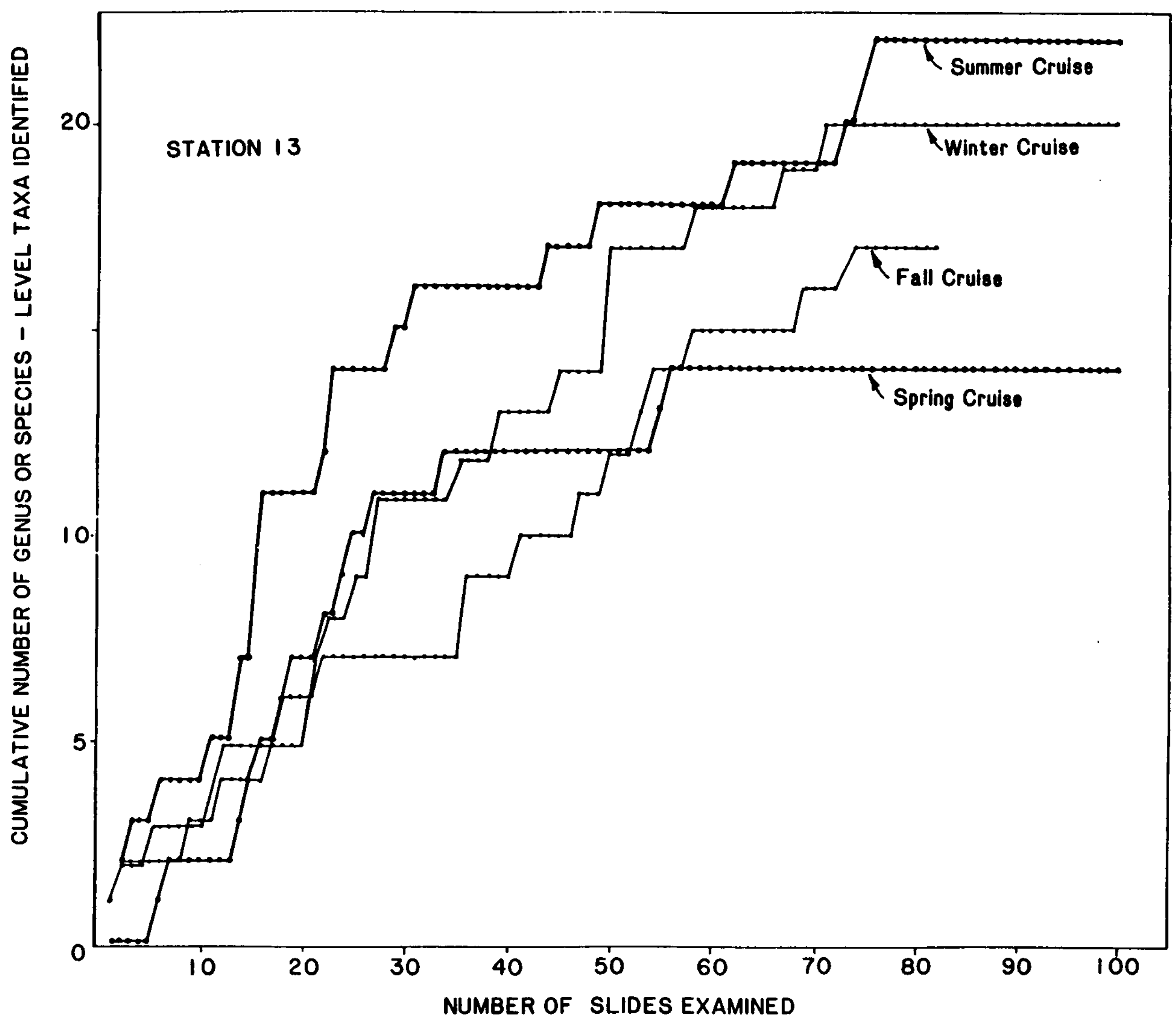


Figure 6-42. Taxa saturation curves for photographic data from Station 13. Only genus or species level taxa are included.

Table 6-95. Statistics and confidence limits for total biotal cover estimates.

Station/ Cruise	Statistics				
	Mean % Biotic Cover	Standard Deviation	Number of Slides (n)	95% Confidence Limits for Mean	95% Confidence Range as % of Mean
1/Fall	15.38	11.50	99	13.08-17.68	30
1/Spring	20.00	15.20	100	16.98-23.02	30
1/Summer	26.76	17.49	100	23.28-30.24	26
1/Winter	13.33	9.39	63	10.96-15.70	35
3/Fall	7.50	6.65	36	5.26-9.74	60
3/Spring	16.57	12.26	68	13.60-19.54	36
3/Summer	18.63	14.77	93	15.58-21.68	33
3/Winter	13.10	9.99	20	8.42-17.78	71
7/Fall	14.89	18.70	28	7.64-22.14	97
7/Spring	15.64	9.21	56	13.18-18.10	31
7/Summer	17.73	15.09	100	14.73-20.73	34
7/Winter	14.33	11.61	39	10.57-18.09	52
9/Fall	16.24	13.51	100	13.55-18.93	33
9/Spring	14.63	10.05	100	12.63-16.63	27
9/Summer	18.83	10.10	100	16.82-20.84	21
9/Winter	13.18	7.69	38	10.66-15.70	38
10/Fall	11.26	5.84	100	10.10-12.42	21
10/Spring	22.24	13.04	100	19.65-24.83	23
11/Fall	41.24	19.10	100	37.44-45.04	18
11/Spring	7.17	4.82	100	6.21-8.13	27
11/Summer	31.35	14.29	100	28.51-34.19	18
11/Winter	15.21	6.72	56	13.41-17.01	24

Table 6-95. Continued.

Station/ Cruise	Statistics				
	Mean % Biotic Cover	Standard Deviation	Number of Slides (n)	95% Confidence Limits for Mean	95% Confidence Range as % of Mean
13/Fall	18.70	10.32	82	16.42-20.98	24
13/Spring	22.04	18.03	100	18.45-25.63	33
13/Summer	60.22	24.14	100	55.42-65.02	16
13/Winter	22.23	17.67	100	18.71-25.75	31
15/Fall	19.15	13.78	100	16.41-21.89	28
15/Spring	19.79	15.71	99	16.65-22.93	32
15/Summer	49.53	16.51	100	46.24-52.82	13
15/Winter	29.47	16.02	100	26.28-32.66	22
17/Fall	16.07	9.30	42	13.17-18.97	36
17/Spring	8.46	4.92	100	7.48-9.44	23
19/Fall	19.48	14.47	64	15.86-23.10	37
19/Spring	13.72	10.72	100	11.59-15.85	31
21/Fall	17.89	11.35	98	15.61-20.17	26
21/Spring	19.89	12.61	100	17.38-22.40	25
21/Summer	57.38	20.04	100	53.39-61.37	14
21/Winter	23.23	11.23	97	20.96-25.50	20
23/Fall	34.66	9.65	100	32.74-36.58	11
23/Spring	37.12	15.29	99	34.06-40.18	16
23/Summer	67.98	15.16	100	64.96-71.00	9
23/Winter	25.89	11.49	99	23.59-28.19	18
27/Fall	7.42	4.35	31	5.82-9.02	43
27/Spring	11.49	8.85	100	9.73-13.25	31

Table 6-95. Continued.

Station/ Cruise	Statistics				
	Mean % Biotic Cover	Standard Deviation	Number of Slides (n)	95% Confidence Limits for Mean	95% Confidence Range as % of Mean
29/Fall	64.53	11.94	100	62.15-66.91	7
29/Spring	79.60	11.37	100	77.34-81.86	6
29/Summer	89.76	4.68	100	88.83-90.69	2
29/Winter	74.86	11.88	100	72.50-77.22	6
30/Fall	47.78	13.30	100	45.13-50.43	11
30/Spring	50.84	9.85	100	48.88-52.80	8
32/Summer	9.01	5.04	85	7.92-10.10	24
32/Winter	8.18	6.36	17	4.91-11.45	80
35/Summer	21.42	11.23	100	19.19-23.65	21
35/Winter	6.28	3.16	18	4.71-7.85	50
36/Summer	8.58	5.28	76	7.37-9.79	28
36/Winter	13.86	9.10	49	11.25-16.47	38
38/Summer	15.49	7.67	100	13.96-17.02	20
38/Winter	10.71	5.27	58	9.33-12.09	26
39/Summer	54.10	14.12	100	51.29-56.91	10
39/Winter	17.10	6.14	84	15.76-18.44	16

Table 6-96. Statistics and confidence limits for percent cover of selected organisms/groups to illustrate the range of confidence in percent cover estimates.

Organism or Group	Station/ Cruise	Statistics				
		Mean % Biotic Cover	Standard Deviation	Number of Slides (n)	95% Confidence Limits for Mean	95% Confidence Range as % of Mean
Anadyomene menziesii	29/Fall	36.16	19.06	100	32.37-39.95	21
Gorgoniídae	13/Winter	11.40	14.33	100	8.55-14.25	50
Crinoidea	32/Winter	5.65	7.43	17	1.83-9.47	135
Ellisella barbadensis	35/Winter	1.00	1.71	18	0.15-1.85	170

Calculation of confidence intervals for the mean provides information on precision of cover estimates. However, both precision and accuracy are of concern; the number of slides must be sufficient to average over spatial variability to produce a reliable estimate of the "true" mean cover. Figure 6-43 illustrates this problem for three stations with a wide range of total biotal cover values. Mean cover estimates were plotted against the number of slides included in the calculation; replicates were ordered arbitrarily (in one of the 100! possible permutations) for the calculations. All three examples indicate that: 1) examination of fewer than 10 slides is likely to risk a serious error in the cover estimate, and 2) examination of 50 or more slides is likely to produce an accurate cover estimate in most instances. It is significant, however, that none of the curves had completely stabilized even after 100 slides had been included.

It should be noted that these calculations assume that the patchiness of live bottom biota within a 1-km^2 station is of a scale that is either small enough to be adequately "averaged over" on a given survey or large enough to encompass the entire station. Although transect surveys on each subsequent sampling date were to cover the same "track" initially photographed, in practice this was not completely successful. Some apparent seasonal differences in epibiotal cover noted in this study probably reflect large-scale patchiness within a station.

It is evident that dredges, trawls, and photographic analyses had sampling adequacy problems that could be overcome by increasing the number of replicates. Yet the general usefulness of (especially) dredge and photographic data in the delineation of species groupings and seasonality suggests that the level of adequacy was consistent enough to produce a fairly complete description of live bottom communities. Furthermore, selection of sample size in an extensive survey such as this inevitably involves a compromise between intensive sampling at particular stations and breadth of coverage within the study area. The balance between these factors is determined by the objective of the study, which in this case was to provide a broad baseline characterization of shelf live bottom habitats.

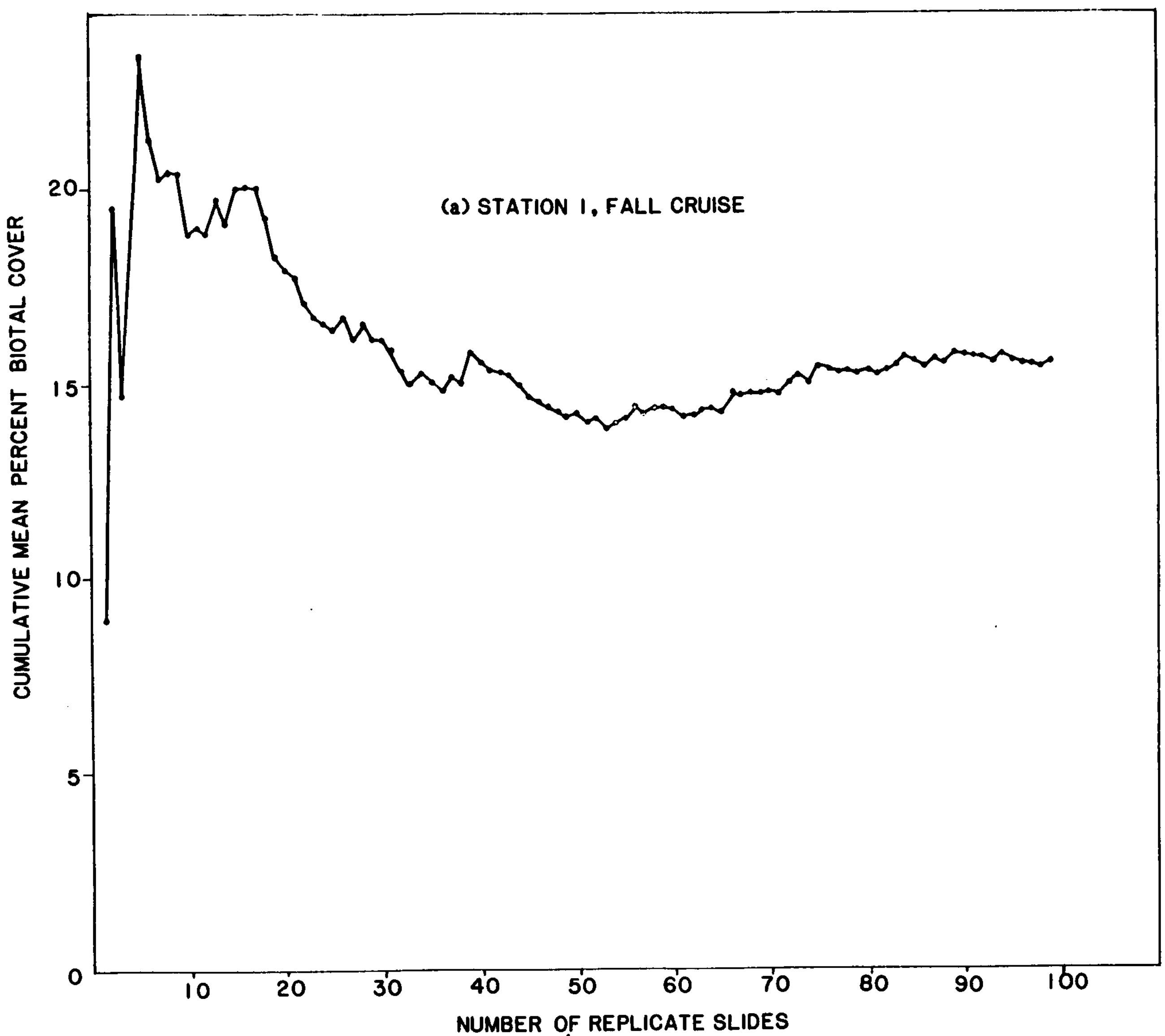


Figure 6-43a. Station 1, Fall Cruise: Variation in estimated mean biotal cover depending on number of slides examined. Slides were ordered arbitrarily.

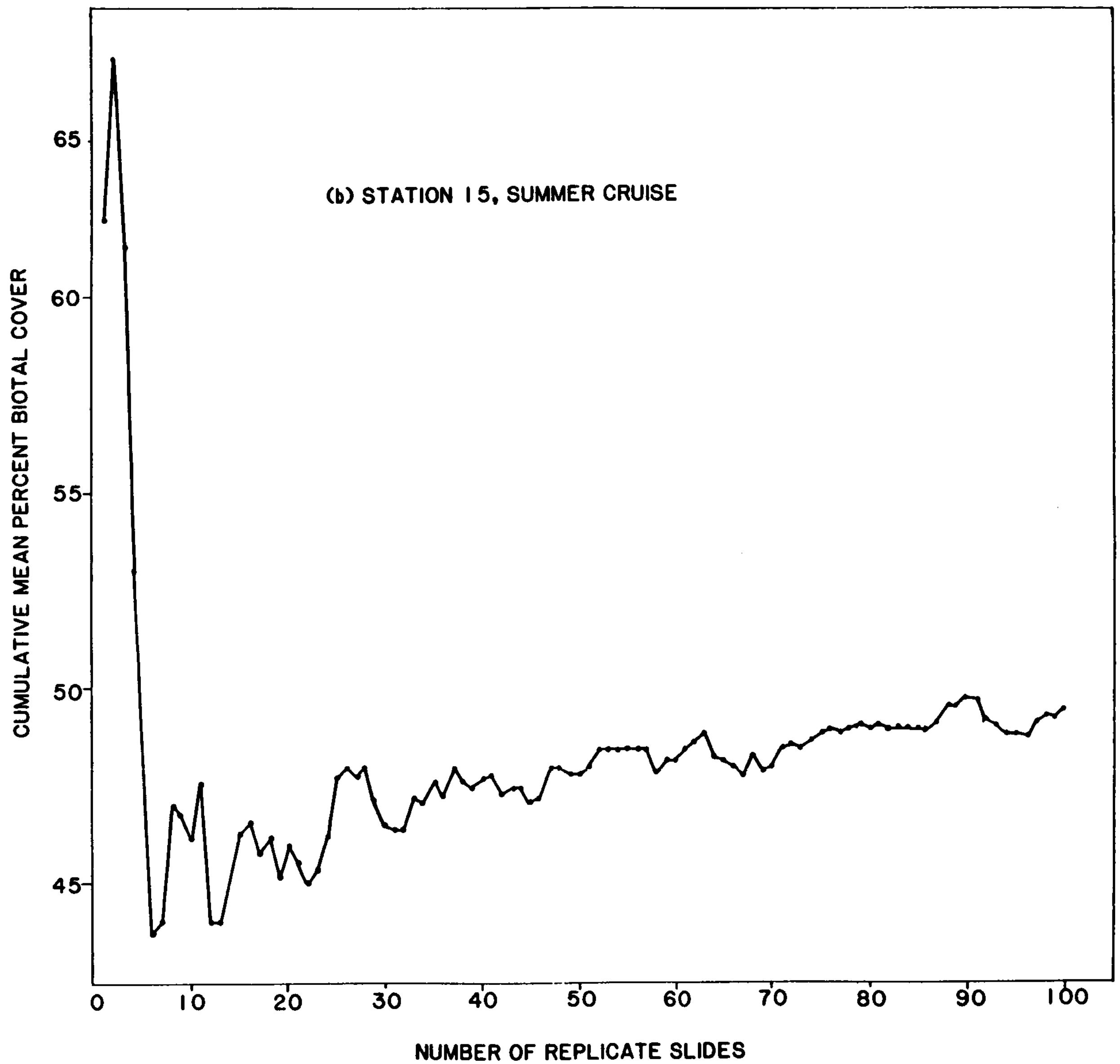


Figure 6-43b. Station 15, Summer Cruise: Variation in estimated mean biotal cover depending on number of slides examined. Slides were ordered arbitrarily.

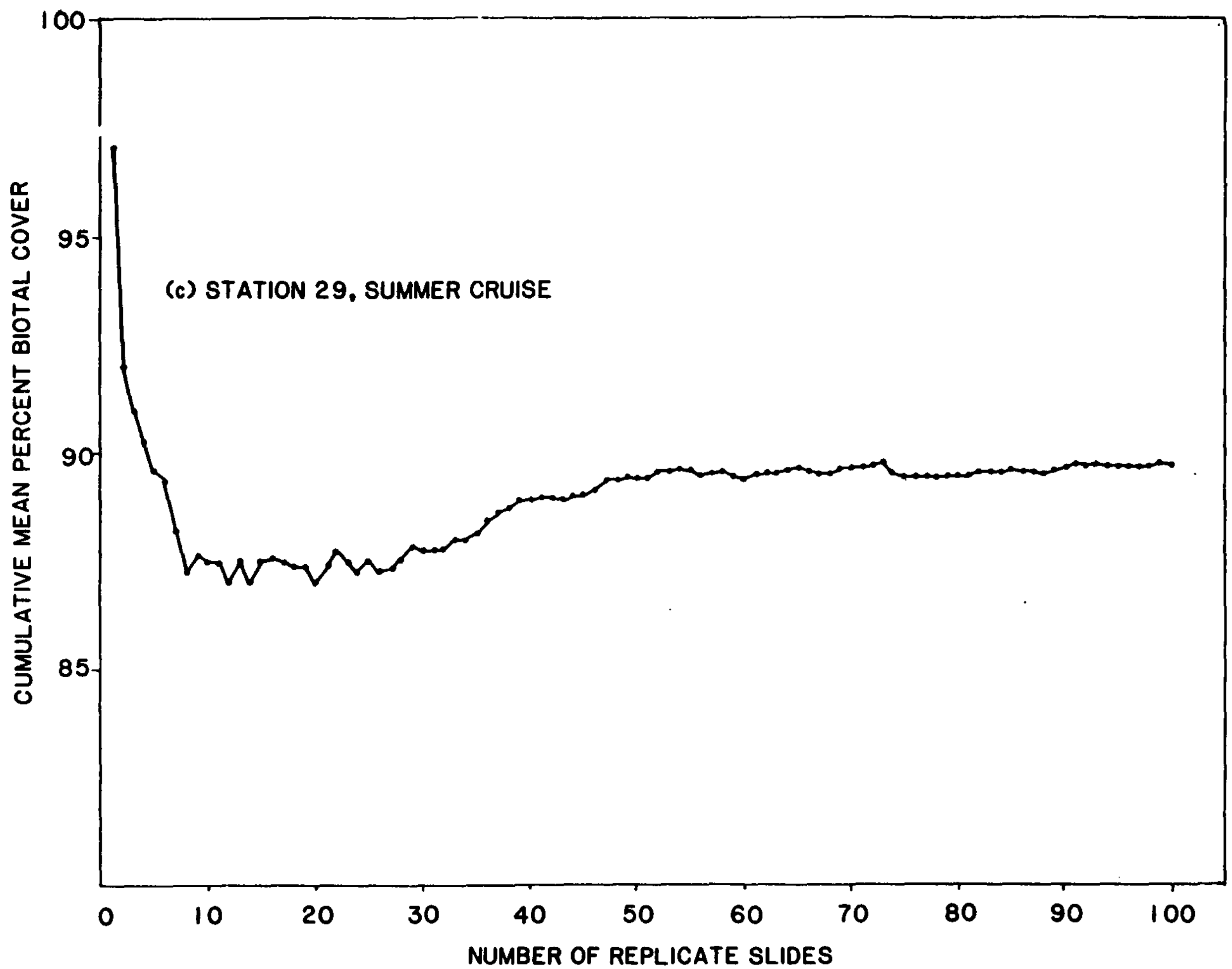


Figure 6-43c. Station 29, Summer Cruise: Variation in estimated mean biotal cover depending on number of slides examined. Slides were ordered arbitrarily.

6.6.3.5 Methodology Recommendations

Methodology should be selected on the basis of the objectives of a study. In the present study, the emphasis was on providing a shelfwide baseline characterization of live bottom habitats, station-specific information on the composition, relative abundance, and seasonality of live bottom biota, and relationships to possible controlling environmental variables (discussed in Section 8.0). If a similar study were to be initiated, we would make the following recommendations:

1) Triangle dredge sampling should be the primary method for collecting epibiota, with an increased number of dredges per sampling survey. The required number should be determined by conducting an intensive pilot study (at one or more representative stations) to assure that sampling is adequate to obtain most taxa on all surveys at a given station; more intensive sampling at other locations on the shelf (CSA, unpublished) indicates that seven or more dredges per station are likely to be necessary.

2) If trawl sampling is used, replicate trawls should be obtained (e.g., at least two) or a larger trawl employed to increase the size of the catch. Single larger trawls, such as the 12.2m (40-ft) semiballoon trawl used in the baseline characterization of live bottom habitats in the South Atlantic Bight [Marine Resources Research Institute (MRRI), 1982], could be suitable if their adequacy were known or determined (e.g., by intensive trawling at representative stations).

3) Photographic analysis should be used to estimate relative abundance and total cover of epibiota. In general, at least 100 usable slides per station/survey should be examined; larger or smaller numbers may suffice depending on the desired level of confidence and the spatial variability present at a station.

4) Supporting environmental data should be obtained at all stations on each date that biological sampling is conducted (Green, 1979). Some environmental sampling was deleted in the Year Two program to save money, creating

problems in the analysis of biological vs. physical variables (Section 8.0).

Other future studies are likely to focus on the development of a monitoring capability for live bottom biota. A different approach and different methodology will be needed in such studies. Binary data from dredges and trawls are insensitive to changes in relative abundance; large numbers of replicates would need to be collected to confidently assert that a change in species richness or relative frequency of occurrence had taken place. In addition, dredge and trawl sampling is destructive. Remote photography provides a non-destructive, quantitative tool, but taxonomic resolution is variable; changes in average percent cover could be monitored only for selected, identifiable taxa and for all epibiota combined. The most useful approach would be to repeatedly photograph marked areas (e.g., quadrats); even if individuals or colonies could not be identified to genus or species, they could be separately distinguished. Appearance, disappearance, and growth rates of individuals or colonies could easily be assessed. This approach would be most practically applied in areas shallow enough to be accessible to divers.

6.6.4 Need for Further Study

The continental shelf off southwest Florida is still a relatively unstudied habitat. The present study has provided a general descriptive characterization of live bottom communities and opens the way for a variety of possible research efforts that may serve to elucidate functional and causal relationships or develop refined capabilities to detect changes that could result from oil and gas drilling and production activities.

Some future study needs have already been determined and are being addressed by ongoing aspects of the Southwest Florida Shelf Ecosystems Study series. Year Three efforts have focused on describing shallower live bottom communities and evaluating and comparing certain sampling techniques. Years Four and Five efforts are to address seasonality and benthic dynamics, including sediment movement and larval recruitment.

Future work oriented toward producing a general understanding of the biology of live bottom communities, relationships to environmental variables, and the functional aspects of live bottom ecosystems should include efforts to:

1) quantify biomass and energy flow at particular locations;

2) elucidate physiological characteristics and rate processes of particularly important groups--e.g., sponges;

3) determine sources, nutritional characteristics, and supply rates of particulate organic matter being deposited in live bottom habitats; and

4) identify trophic relationships, especially those involving commercially important fishes or shellfishes.

Conducting research at depths that are not readily accessible to divers is problematic and will require innovative approaches such as the use of submersibles for observation and experimentation (Reed, 1981, 1983).

Specific applied research efforts should focus on the development of a monitoring capability for live bottom biota and on the persistence, resistance, and resilience of the biota in the face of natural and human-induced disturbance. As discussed in Section 6.6.3, we suggest that monitoring may best be accomplished by use of repeatable photography of marked quadrats or transects, thus avoiding the primary disadvantage of random, remote photography--low taxonomic resolution. Implementation of this approach at depths inaccessible to divers will also require some innovative techniques. The other area for research to assess potential effects of oil and gas activities concerns the "stability" of live bottom assemblages. Little is known about short-term temporal variations in abundance and turnover rates. Little is known about how frequently natural disturbance (e.g., sediment movement, storm damage, red tides) affects these communities, how susceptible to potential effects of oil and gas activities (e.g., increased deposition of fine sediment) the biota are, and how quickly recovery can occur. These problems can best be addressed using in situ photographic and instrumentation arrays and field and laboratory experimentation.

7.0 SOFT BOTTOM BIOTA

7.1 INTRODUCTION

Nineteen soft bottom benthic stations were sampled during the two years of the program. The locations of soft bottom stations are shown in Figure 7-1. Fifteen stations at depths ranging from 23 to 90m were sampled during the first two cruises (Year One); for the two Year Two cruises, four of these stations were replaced by stations ranging in depth from 136 to 148m. Station depths and sampling dates are summarized in Table 7-1.

This section describes the results of biological sampling at the soft bottom stations. Characteristics of individual stations are described first, followed by shelfwide distribution and zonation patterns and seasonality. The ecology of soft bottom communities of the shelf is then discussed and the results compared with those of previous studies in the area. Environment-organism relationships are discussed in the context of the shelf as an ecosystem in Section 8.0.

7.2 METHODOLOGY

All methodology has been described in detail in Section 3.0. Briefly, samples of soft bottom biota were obtained by two methods: 1) a modified Reineck box core sampler (19 x 30 x 40cm deep) (Bouma and Marshall, 1964; Farris and Crezee, 1976); and 2) a Marinovich 7.6m semiballoon otter trawl with 3.8cm stretch mesh in the body of the net and 1.3cm mesh in the cod end. Generally, five box cores and one trawl sample were obtained per station on each sampling date. The box core samples were processed on board the ship by elutriating the sediment in a sieving device through a 0.5mm mesh sieve. Box core and trawl specimens were then preserved for later laboratory identification.

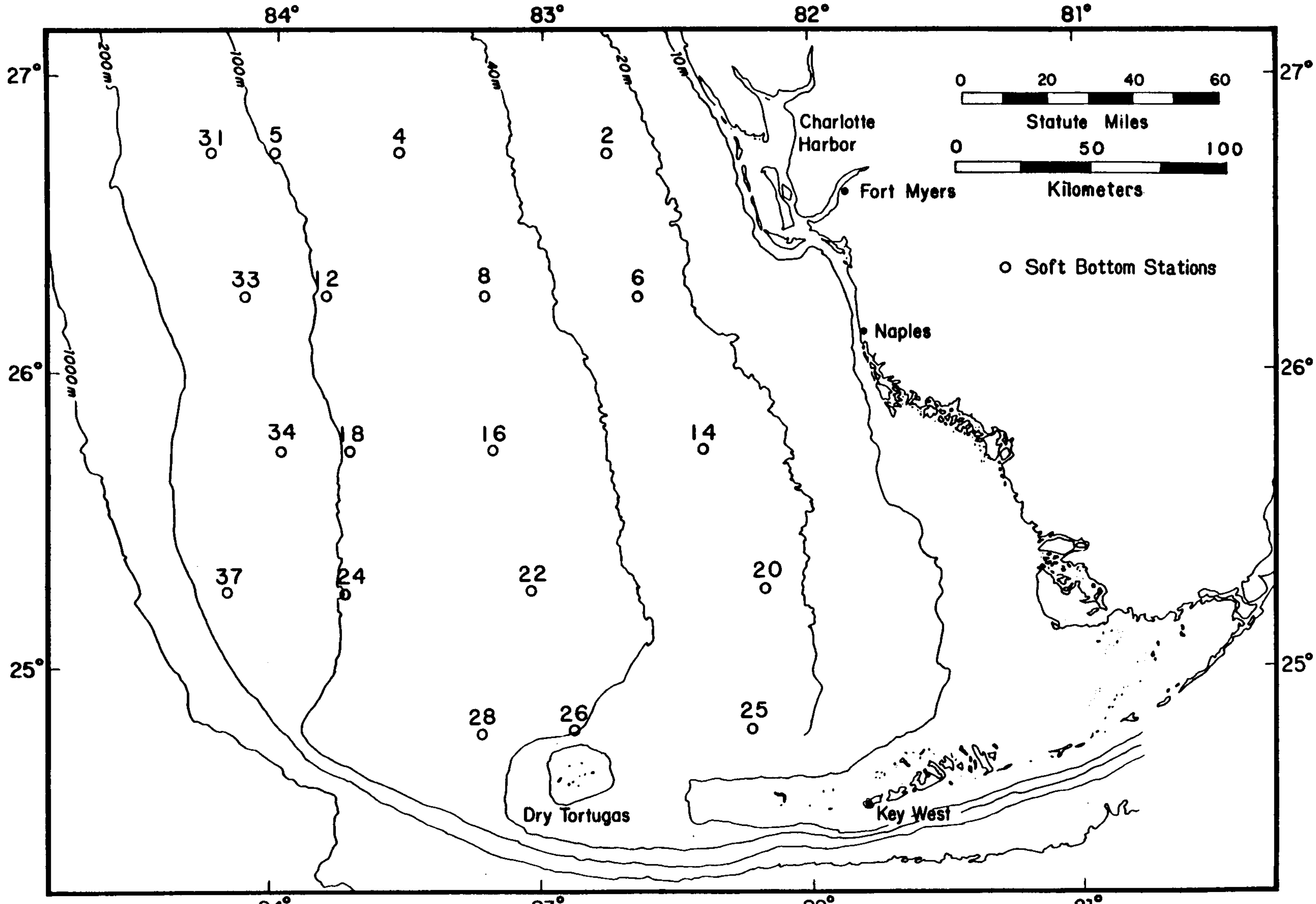


Figure 7-1. Location of soft bottom biological sampling stations.

Table 7-1. Summary of station depths and sampling frequency for soft bottom stations.

Station	Transect	Depth (m)	Cruise			
			Fall	Spring	Summer	Winter
2	A	25	X	X		
4	A	55	X	X	X	X
5	A	90	X	X	X	X
6	B	26	X	X	X	X
8	B	48	X	X		
12	B	90	X	X	X	X
14	C	26	X	X	X	X
16	C	54	X	X	X	X
18	C	86	X	X		
20	D	23	X	X	X	X
22	D	52	X	X	X	X
24	D	88	X	X	X	X
25	E	24	X	X	X	X
26	E	38	X	X		
28	E	59	X	X	X	X
31	A	142			X	X
33	B	146			X	X
34	C	136			X	X
37	D	148			X	X

Fall Cruise = Year One, Cruise 3 (Oct-Nov 1980)
Spring Cruise = Year One, Cruise 4 (Apr-May 1981)
Summer Cruise = Year Two, Cruise 2 (Jul-Aug 1981)
Winter Cruise = Year Two, Cruise 3 (Jan-Feb 1982).

7.3 ECOLOGICAL CHARACTERIZATION OF INDIVIDUAL STATIONS

Individual station descriptions include a brief review of station physical features, followed by quantitative characterizations of the infauna. Trawl data are considered only semi-quantitative (see Section 7.5.3), but commonly collected species are cited in the text along with their known substrate affinities (e.g., soft bottom or live bottom).

7.3.1 Station 2

Physical Features -- Station 2 was located at 26°45.84'N, 82°45.18'W; 43 km from shore. Across the station there was a downward slope from ESE to WNW, with depths ranging from 24 to 26.5m. A series of ridges and troughs (NNE-SSW axes) crossed the site from ESE to WNW. Soft bottom substrates, consisting of fine to medium sand, predominated at this location.

Taxonomic Richness & Composition -- Table 7-2 summarizes the taxonomic richness and general composition of the biota at Station 2. Numbers of taxa (identified to genus or species level) within major groups captured are presented comparatively for the two sampling techniques used. The first and second columns list the numbers of taxa recorded from box core (BCI) and otter trawl (OTS) sample analyses, respectively. The third column lists the numbers of additional taxa that were collected in the otter trawls but not in the box cores. The fourth column lists the cumulative numbers of taxa for both techniques combined.

At Station 2, 243 taxa (identified to genus or species) were collected during the first two cruises (the station was not sampled during Year Two) (Table 7-2). Most (88%) were infaunal organisms, identified from box core samples. Annelida (polychaetes) and Crustacea contributed 51 and 30% of all taxa observed, respectively.

Infaunal Abundance, Diversity, & Equitability -- Table 7-3 summarizes faunal density estimates and diversity and equitability values from box core data from Station 2. The table includes ranges of values observed at all soft bottom stations for comparison. Faunal density was higher on the Spring than Fall

Table 7-2. Soft bottom Station 02, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	4	4	4
PHAEOPHYCOPHYTA	0	1	1	1
RHODOPHYCOPHYTA	0	2	2	2
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	0	0	0
CNIDARIA	1	0	0	1
ANNELIDA	124	0	0	124
GASTROPODA	3	0	0	3
POLYPLACOPHORA	1	0	0	1
APLACOPHORA	0	0	0	0
BIVALVIA	11	0	0	11
SCAPHOPODA	0	0	0	0
CEPHALOPODA	0	0	0	0
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	66	7	6	72
SIPUNCULA	4	0	0	4
PRIAPULIDA	0	0	0	0
PHORONIDA	1	0	0	1
ECTOPROCTA	1	0	0	1
BRACHIOPODA	1	0	0	1
ECHINODERMATA	0	3	3	3
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	0	0	0
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	0	13	13	13
TOTAL	214	30	29	243

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-3. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 2.

Parameter	Cruise*				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	6,696	9,200	-	-	7,948	2,210 - 18,233
Diversity Index	1.79	1.30	-	-	1.54	1.13 - 1.97
Equitability	0.81	0.67	-	-	0.74	0.54 - 0.86

*Station 2 was not sampled on the Year Two (Summer and Winter) Cruises.

Cruise; the mean was in the mid range of densities observed at other stations. Diversity was high on the Fall Cruise and low on the Spring Cruise, with an average in the low to mid range of values observed. Equitability was also higher on the Fall Cruise; the mean of 0.74 was moderately high.

Dominant Infaunal Taxa -- Table 7-4 lists the taxa that were among the five most abundant for one or more cruises, on the basis of box core data. These are subsequently referred to as "dominant" taxa. Eight of the nine taxa were polychaetes. Only the paraonid polychaete *Cirrophorus americanus* was among the dominants for both cruises, and five taxa were dominant on one cruise but absent from the other. These differences indicate a distinct difference in the composition of the infaunal assemblage at Station 2, although assessment of any seasonal pattern is precluded because there were only two sampling dates. Results of weighted discriminant analysis of station/season groupings (see Section 8.2.2) suggest that the difference in infaunal assemblage composition is due to different sediment types sampled on the two cruises.

Macroepifauna -- The macroepifauna collected at Station 2 were typical of fine to coarse sand habitats. All of the fish species encountered are commonly found on a sandy bottom (lizardfishes, *Synodus* spp.; sea robins, *Prionotus* spp.; flounders, *Syacium* spp. and *Bothus* spp.; and sand perch, *Diplectrum formosum*). Sandy substrata are also preferred by all of the invertebrates collected (echinoderms, *Encope michelini* and *Astropecten* sp.; and crustacean species *Portunus* spp. and *Metapenaeopsis goodei*, as well as commercially important shrimps *Penaeus duorarum* and *Sicyonia brevirostris*).

7.3.2 Station 4

Physical Features -- Station 4 was located at 26°45.81'N, 83°32.12'W; 113 km from shore. Across the station there was a slight downward slope from east to west, with depths ranging from 55 to 56.5m. Soft bottom substrates, consisting of medium to coarse sand, predominated.

Taxonomic Richness & Composition -- At Station 4, 486 taxa (identified to genus or species) were taken by box core and otter trawl (Table 7-5). Approximately

Table 7-4. Dominant taxa for Station 2, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise*	
	Fall	Spring
Eunice vittata (P)	1	(-)
Cirrophorus americanus (P)	2	3
Pseudovermiliopsis occidentalis (P)	3	(-)
Palaenotus sp. A (P)	4	(+)
Pisione remota (P)	5	(-)
Prionospio cristata (P)	(+)	1
Fabricia sp. (P)	(+)	2
Aricidea fragilis (P)	(-)	4
Cyclaspis sp. A (Cu)	(-)	5

(P) = Polychaeta (+) present but not among the five most abundant
(Cu) = Cumacea (-) = absent

*Station 2 was not sampled on the Year Two (Summer and Winter) Cruises.

Table 7-5. Soft bottom Station 04, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	3	3	3
PHAEOPHYCOPHYTA	0	1	1	1
RHODOPHYCOPHYTA	0	1	1	1
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	13	13	13
CNIDARIA	1	0	0	1
ANNELIDA	189	2	0	189
GASTROPODA	13	7	7	20
POLYPLACOPHORA	1	0	0	1
APLACOPHORA	3	0	0	3
BIVALVIA	44	3	3	47
SCAPHOPODA	5	0	0	5
CEPHALOPODA	0	9	9	9
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	104	28	25	129
SIPUNCULA	1	0	0	1
PRIAPULIDA	1	0	0	1
PHORONIDA	0	0	0	0
ECTOPROCTA	1	0	0	1
BRACHIOPODA	1	0	0	1
ECHINODERMATA	4	10	10	14
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	1	2	2	3
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	0	42	42	42
TOTAL	370	119	116	486

BCI = Box core infauna; OTS = Otter trawl, soft bottom

76% of these were infaunal biota, identified from box core samples. Predominant groups at the site included Annelida (polychaetes) (39%), Crustacea (27%), Bivalvia (10%), and Gnathostomata (fishes) (9%). These groups contributed 85% of all taxa collected.

Infaunal Abundance, Diversity, & Equitability -- Table 7-6 summarizes faunal density estimates and diversity and equitability values for box core data from Station 4. Faunal densities were generally low, and values for the Fall and Summer Cruises were lower than for the Winter and Spring Cruises, indicating a possible seasonal abundance pattern. Diversity values were consistently high, with a somewhat lower value for the Winter Cruise than for all other cruises. Equitability values were also among the highest observed, with the Winter Cruise value being somewhat lower than values from the other cruises.

Dominant Infaunal Taxa -- Table 7-7 lists the most abundant taxa from box core data from Station 4. Of the 14 taxa, 11 were polychaetes, 1 was a bryozoan, 1 was a urochordate (ascidian), and 1 was a polyplacophoran mollusc. The pilargid polychaete *Synelmis albini* was consistently first or second in abundance, but only three other taxa (the polychaetes *Goniadides carolinae*, Ampharetidae genus B, and *Palaenotus* sp. A) were dominants on more than one cruise. Two polychaetes, the glycerid *Glycera oxycephala* and the orbiniid *Haploscoloplos* sp., were dominants on one cruise but entirely absent from the others, indicating pronounced seasonal abundance patterns. *Haploscoloplos* sp. was typically abundant at many middle and outer shelf stations on the Winter Cruise.

Macroepifauna -- Most of the fishes and macroinvertebrates collected during both sampling years are typical of live bottom areas. Six of 18 of the invertebrate species collected on the Spring Cruise and 8 of 39 collected on the Winter Cruise were sponges. Other invertebrates found at this station during all sampling periods were also predominantly live bottom or reef dwellers (echinoderms, *Stylocidaris affinis*, *Comactinia meridionalis*, and *Echinaster* spp.; crustaceans, *Stenorhynchus seticornis*, *Stenocionops furcata coelata*, and *Munida* sp.; and molluscs, *Octopus* spp. and *Vermicularia knorrii*). Some of the more motile species of shrimps and crabs collected, such as *Sicyonia brevirostris*, *Solenocera atlantidis*, *Metapenaeopsis goodei*, and *Trachypenaeus* sp.,

Table 7-6. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 4.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	2,767	5,003	3,620	6,096	4,372	2,210 - 18,233
Diversity Index	1.77	1.85	1.82	1.68	1.78	1.13 - 1.97
Equitability	0.84	0.82	0.83	0.76	0.81	0.54 - 0.86

Table 7-7. Dominant taxa for Station 4, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Synelmis albini (P)	1	1	1	2
Goniadides carolinae (P)	2	(+)	(-)	3
Selenaria sp. (B)	3	(+)	(+)	(+)
Lysippe cf. annectens (P)	4	(+)	(+)	(+)
Amaroucium sp. (U)	5	(-)	(-)	(-)
Sphaerosyllis sp. (P)	(+)	2	(+)	(+)
Fabricia sp. (P)	(+)	3	(+)	(+)
Ampharetidae genus B (P)	(-)	4	4	(+)
Paleanotus sp. A (P)	(+)	5	(+)	4
Glycera oxycephala (P)	(-)	(-)	2	(-)
Prionospio cristata (P)	(+)	(+)	3	(+)
Ischnochiton sp. (Pp)	(+)	(+)	5	(-)
Haploscoloplos sp. (P)	(-)	(-)	(-)	1
Pholoe minuta (P)	(+)	(+)	(-)	5

(P) = Polychaeta
(B) = Bryozoa
(U) = Urochordata
(Pp) = Polyplacophora
(+) = present but not among five most abundant
(-) = absent

prefer the sandy, crushed shell habitat. A majority of the fish species collected were also live bottom or reef dwellers and include scorpionfishes, Scorpaena spp.; sea basses, Centropristis spp.; eel, Gymnothorax saxicola; and lined sea horse, Hippocampus erectus. The most abundant in trawl catches were sand/shell dwellers including lizardfishes, Synodus spp. and Saurida spp.; flounders, Syacium spp. and Bothus spp.; fringed filefish, Monacanthus ciliatus; and sand perch, Diplectrum formosum.

7.3.3 Station 5

Physical Features -- Station 5 was located at 26°45.70'N, 84°00.13'W; 159 km from shore. Across the station there was a general downward slope from northeast to southwest. Depth ranged from 88 to 92.5m. Soft bottom substrates, consisting of coarse sand, predominated at this site.

Taxonomic Richness & Composition -- Benthic biological collections yielded 445 taxa (identified to genus or species) at Station 5 (Table 7-8). Box core samples contributed about 68% of these taxa. Five major groups accounted for 89% of all taxa identified at this location. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (35%), Crustacea (33%), Gnathostomata (fishes) (9%), Bivalvia (7%), and Porifera (5%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-9 summarizes faunal density estimates and diversity and equitability values for box core data from Station 5. Faunal densities were consistently among the lowest observed at any station. As at Station 4, densities were somewhat higher on the Winter and Spring Cruises than on the Summer and Fall Cruises, but the variation was less pronounced than at the former station. Diversity was moderately high and was distinctly higher on the Spring Cruise than on all other cruises. Equitability was high and seasonally consistent.

Dominant Infaunal Taxa -- Table 7-10 lists the most abundant taxa from box core data from Station 5. Eleven of the 13 taxa were polychaetes, the others being a brachiopod and an ostracod. The pilargid polychaete Synelmis albini was consistently the most abundant taxon, and Ampharetidae genus B was second on three

Table 7-8. Soft bottom Station 05, all cruises combined: Number of taxa identifed to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	1	1	1
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	21	21	21
CNIDARIA	1	0	0	1
ANNELIDA	157	0	0	157
GASTROPODA	5	11	10	15
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	4	0	0	4
BIVALVIA	28	3	1	29
SCAPHOPODA	3	0	0	3
CEPHALOPODA	0	5	5	5
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	100	50	45	145
SIPUNCULA	0	0	0	0
PRIAPULIDA	0	0	0	0
PHORONIDA	1	0	0	1
ECTOPROCTA	1	0	0	1
BRACHIOPODA	2	0	0	2
ECHINODERMATA	0	13	13	13
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	5	5	5
CHORDATA-CEPHALOCHORDATA	0	0	0	0
CHORDATA-GNATHOSTOMATA	0	42	42	42
TOTAL	302	151	143	445

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-9. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 5.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	2,227	3,710	2,680	3,313	2,983	2,210 - 18,233
Diversity Index	1.51	1.72	1.58	1.59	1.60	1.13 - 1.97
Equitability	0.75	0.79	0.76	0.76	0.76	0.54 - 0.86

Table 7-10. Dominant taxa for Station 5, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Synelmis albini (P)	1	1	1	1
Ampharetidae genus B (P)	2	(-)	2	2
Lysippe cf. annectens (P)	3	(+)	(-)	(-)
Platidia clepsydra (Br)	4	3	(+)	(+)
Fabricia sp. (P)	5	5	3	(+)
Glycera oxycephala (P)	(-)	2	(+)	5
Sphaerosyllis sp. (P)	(+)	4	(+)	(+)
Protodorvillea kefersteini (P)	(+)	5	(+)	(+)
Prionospio cirrobranchiata (P)	(-)	5	(+)	(+)
Euchone incolor (P)	(-)	(+)	4	(+)
Armandia maculata (P)	(-)	(+)	5	(-)
Haploscoloplos sp. (P)	(-)	(-)	(-)	3
Rutiderma mollitum (O)	(-)	(+)	(+)	4

(P) = Polychaeta
(Br) = Brachiopoda
(O) = Ostracoda

(+) = present but not among five most abundant
(-) = absent

of the four cruises. Eight taxa were dominants on only one cruise, including (as noted for Station 4) Haploscoloplos sp.

Macroepifauna -- Macroepifaunal specimens collected at Station 5 were typical of live bottom habitats and included a large number of sponge species, especially during Year One (13 of 54, or 24% of the total number of invertebrate species collected in the Fall Cruise; 9 of 32, or 28% of invertebrate species collected on the Spring Cruise). Fewer sponge species were found in Year Two collections, but the other groups of invertebrates commonly associated with live bottom habitats were well represented. Over 60% of all species of macroinvertebrates collected from all four cruises of Years One and Two were those species common to live bottom areas. The crustacean Munida sp. was very numerous during the Fall Cruise (34% of the total number of individuals collected) and the Summer Cruise (48% of the total). Other dominant live bottom or reef dwellers included arrow crabs, Stenorhynchus spp.; echinoderms, Stylocidaris affinis and Comactinia meridionalis; and ascidians, Polycarpa obtecta; very few strictly "sand dwelling" species were present.

The fish community, on the other hand, was a mixture of species found on sand and live bottoms. The dominant sand bottom species included lizardfishes, Synodus spp. and Saurida spp.; sea robins, Prionotus spp.; batfishes, Ogcocephalus spp. and Halieutichthys aculeatus; and flounders, Syacium papillosum and Citharichthys spp. Reef dwellers were represented by the scorpionfishes, Scorpaena spp.; and sea basses, Centropristus spp. Centropristus ocyurus was one of the more abundant fish species collected during the Fall Cruise and Centropristis sp. was abundant on the Summer Cruise.

7.3.4 Station 6

Physical Features -- Station 6 was located at 26°16.79'N, 82°38.35'W; 60 km from shore. Across the station block there was a general downward slope from east to west. Depths ranged from 26 to 27.5m. Soft bottom substrates, consisting of fine to very fine sands, predominated at this site.

Taxonomic Richness & Composition -- In all, 352 taxa (identified to genus or species) were collected at Station 6 (Table 7-11). Most (73%) were infaunal organisms taken by box core. Five major groups accounted for 94% of all taxa identified at this location. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (32%), Crustacea (32%), Gnathostomata (fishes) (12%), Bivalvia (11%), and Gastropoda (7%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-12 summarizes faunal density estimates and diversity and equitability values for box core data from Station 6. With the exception of the low Spring Cruise results, densities were among the highest observed. No seasonal pattern is evident. Diversity values were low on all cruises and the low Summer Cruise value was the lowest observed at any station. Equitability values followed a similar pattern and were among the lowest observed.

Dominant Infaunal Taxa -- Table 7-13 lists the most abundant taxa from box core data from Station 6. Eleven of the 13 taxa were polychaetes; the others were a bivalve and a cumacean. The polychaetes *Prionospio cristata* (spionid) and *Mediomastus californiensis* (capitellid) were dominants on three cruises but absent from the summer cruise. Summer Cruise dominants, including three species of paraonid *Aricidea*, were generally not among the most abundant species on any other cruise. Thus the Summer Cruise samples had a distinctly different composition from those obtained on other cruises, as also reflected in the very low diversity and equitability values.

Macroepifauna -- Very few sponges were collected at this station and the more predominant taxonomic groups were represented by sand-dwelling species. Penaeid shrimp (including the commercially important species *Penaeus duorarum*, *Penaeus aztecus*, and *Sicyonia brevirostris*) were the most numerous group of invertebrates during each collection period (Fall Cruise--6 species, 63% of all invertebrates; Spring Cruise--6 species, 80%; Summer Cruise--3 species, 54%; Winter Cruise--5 species, 69%). Portunid crabs (*Portunus* spp.) and the mantis shrimps (*Squilla* spp.) were the other dominants. These three groups alone made up more than 90% of the total invertebrate fauna collected and all three groups are typically associated with sandy habitats.

Table 7-11. Soft bottom Station 06, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	1	1	1
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	1	1	1
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	4	4	4
CNIDARIA	0	0	0	0
ANNELIDA	112	1	1	113
GASTROPODA	20	5	5	25
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	0	0	0	0
BIVALVIA	34	3	3	37
SCAPHOPODA	1	0	0	1
CEPHALOPODA	0	3	3	3
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	85	31	28	113
SIPUNCULA	1	1	1	2
PRIAPULIDA	0	0	0	0
PHORONIDA	0	0	0	0
ECTOPROCTA	1	0	0	1
BRACHIOPODA	1	0	0	1
ECHINODERMATA	1	6	6	7
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	0	0	0
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	0	42	42	42
TOTAL	257	98	95	352

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-12. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 6.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	9,393	3,940	14,269	10,187	9,447	2,210 - 18,233
Diversity Index	1.37	1.33	1.13	1.36	1.30	1.13 - 1.97
Equitability	0.68	0.70	0.54	0.68	0.65	0.54 - 0.86

Table 7-13. Dominant taxa for Station 6, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Prionospio cristata (P)	1	3	(-)	2
Lucina radians (Bi)	2	2	(-)	(-)
Mediomastus californiensis (P)	3	4	(-)	1
Myriochele oculata (P)	4	(+)	(+)	(+)
Armandia maculata (P)	5	(+)	(+)	3
Fabricia sp. (P)	(+)	1	(+)	(+)
Cyclaspis sp. A (Cu)	(+)	5	(+)	(+)
Aricidea fragilis (P)	(+)	(+)	1	5
Aricidea philbinae (P)	(+)	(+)	2	(+)
Aglaophamus verrilli (P)	(+)	(+)	3	(+)
Levinsenia acutibranchiata (P)	(-)	(-)	4	(+)
Aricidea sp. B (P)	(-)	(-)	5	(+)
Magelona pettiboneae (P)	(+)	(+)	(+)	4

(P) = Polychaeta
(Bi) = Bivalvia
(Cu) = Cumacea

(+) = present but not among five most abundant
(-) = absent

Over 60% of the fish specimens collected during all four cruises were sand perches (*Diplectrum* spp.), flounders (*Syacium papillosum*, *Bothus* spp., and *Citharichthys* spp.), and filefishes (*Monacanthus* spp.). These, as well as a majority of the other species of fishes collected, are sand dwellers.

7.3.5 Station 8

Physical Features -- Station 8 was located at 26°16.72'N, 83°12.81'W; 111 km from shore. Across the station there was a slight downward slope from east to west, with depths ranging from 48.5 to 50m. Soft bottom substrates, consisting of fine sand, predominated at this site.

Taxonomic Richness & Composition -- Station 8 was sampled only on the first two (Year One) cruises. Benthic biological collections yielded 279 taxa (identified to genus or species) (Table 7-14); approximately 61% of these were infaunal organisms. Five major groups accounted for 91% of all taxa identified at this location. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (32%), Crustacea (32%), Gnathostomata (fishes) (15%), Bivalvia (7%), and Gastropoda (5%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-15 summarizes faunal density estimates and diversity and equitability values for box core data from Station 8. Faunal densities were low and there was little difference between the two seasonal density estimates. Both diversity and equitability values were moderate and seasonally consistent.

Dominant Infaunal Taxa -- Table 7-16 lists the most abundant taxa from box core samples at Station 8. Six of the eight taxa were polychaetes, but the bivalve *Lucina radians* was the most abundant species on both cruises. The spionid polychaete *Prionospio cristata* was also a dominant on both cruises, and most of the other taxa were at least present on both cruises, indicating little seasonal variation at this station.

Macroepifauna -- A majority of the species collected at Station 8 were sand dwellers, but there were many live bottom species, including seven sponges.

Table 7-14. Soft bottom Station 08, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	2	2	2
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	1	1	1
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	7	7	7
CNIDARIA	0	0	0	0
ANNELIDA	89	0	0	89
GASTROPODA	12	3	3	15
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	0	0	0	0
BIVALVIA	19	2	1	20
SCAPHOPODA	1	0	0	1
CEPHALOPODA	0	4	4	4
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	43	48	46	89
SIPUNCULA	1	0	0	1
PRIAPULIDA	0	0	0	0
PHORONIDA	1	0	0	1
ECTOPROCTA	1	0	0	1
BRACHIOPODA	1	0	0	1
ECHINODERMATA	2	3	3	5
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	0	0	0
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	0	41	41	41
TOTAL	171	111	108	279

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-15. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 8.

Parameter	Cruise*				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	5,040	5,570	-	-	5,305	2,210 - 18,233
Diversity Index	1.57	1.59	-	-	1.58	1.13 - 1.97
Equitability	0.77	0.78	-	-	0.78	0.54 - 0.86

*Station 8 was not sampled on the Year Two (Summer and Winter) Cruises.

Table 7-16. Dominant taxa for Station 8, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise*	
	Fall	Spring
Lucina radians (Bi)	1	1
Aricidea fragilis (P)	2	(+)
Prionospio cristata (P)	3	2
Magelona sp. A (P)	4	(+)
Selenaria sp. (B)	5	(+)
Fabricia sp. (P)	(+)	3
Magelona pettiboneae (P)	(+)	4
Ampharetidae genus B (P)	(-)	5

(Bi) = Bivalvia (+) present but not among the five most abundant
(P) = Polychaeta (-) = absent
(B) = Bryozoa

*Station 8 was not sampled on the Year Two (Summer and Winter) Cruises.

Penaeid shrimp (including the commercial species Penaeus duorarum and Sicyonia brevirostris) were the most abundant invertebrates collected (64% of the total number on the Fall Cruise and 45% on the Spring Cruise). These motile species, as well as the crabs, Portunus spp., and the scallop, Argopecten gibbus, prefer sandy/crushed shell habitats.

The live bottom fauna collected was very diverse, with no single dominant species. A variety of spider crabs, shrimps, anomurans, and molluscs that are generally associated with sponge and coral communities were collected.

The fishes collected from both cruises were also a mixture of species that prefer sand and reef habitats, although a majority of the specimens collected were flounders. Other species collected which prefer a sandy substratum include: sea robin, Bellator militaris; sand perches, Diplectrum spp.; and lizardfishes, Synodus spp. Those species that prefer reef or live bottom areas include: scorpionfishes, Scorpaena spp.; eel, Gymnothorax saxicola; cardinalfishes, Apogon spp.; and sea bass, Centropristis ocyurus.

7.3.6 Station 12

Physical Features -- Station 12 was located at 26°16.72'N, 83°47.67'W; 162 km from shore. Across the station block, there was a general downward slope from ENE to WSW. Depths ranged from 88 to 91.5m. Soft bottom substrates, consisting of fine sand, predominated at this site. A few small rock outcrops were also observed.

Taxonomic Richness & Composition -- At Station 12, 393 benthic taxa (identified to genus or species) were collected (Table 7-17); infauna accounted for over 69% of these. Five major groups contributed 91% of all taxa identified at this site. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaeta) (39%), Crustacea (31%), Gnathostomata (fishes) (13%), Gastropoda (5%), and Bivalvia (4%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-18 summarizes faunal density estimates and diversity and equitability values for box core data from

Table 7-17. Soft bottom Station 12, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	6	6	6
CNIDARIA	0	0	0	0
ANNELIDA	153	0	0	153
GASTROPODA	11	9	8	19
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	3	0	0	3
BIVALVIA	15	1	1	16
SCAPHOPODA	3	0	0	3
CEPHALOPODA	0	3	3	3
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	83	43	39	122
SIPUNCULA	0	0	0	0
PRIAPULIDA	0	0	0	0
PHORONIDA	0	0	0	0
ECTOPROCTA	1	0	0	1
BRACHIOPODA	2	0	0	2
ECHINODERMATA	1	8	8	9
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	5	5	5
CHORDATA-CEPHALOCHORDATA	0	0	0	0
CHORDATA-GNATHOSTOMATA	1	50	50	51
TOTAL	273	125	120	393

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-18. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 12.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	3,343	3,833	2,210	3,737	3,281	2,210 - 18,233
Diversity Index	1.65	1.57	1.68	1.56	1.62	1.13 - 1.97
Equitability	0.80	0.75	0.81	0.76	0.78	0.54 - 0.86

Station 12. Faunal densities were consistently low, and the low Summer Cruise value was the lowest observed at any station. Diversity and equitability were moderately high, and for both parameters, Fall and Summer Cruise values were higher than Winter and Spring Cruise values.

Dominant Infaunal Taxa -- Table 7-19 lists the most abundant taxa from box core samples at Station 12. Fifteen of the 17 taxa were polychaetes; the others were a bivalve and a solenogaster (mollusc). The polychaetes *Synelmis albini* (pilargid), *Fabricia* sp. (sabellid), and Ampharetidae genus B were consistently among the dominants on each cruise. Most of the remaining taxa were dominants on one or two cruises, and the bivalve *Sphenia tumida* and the polychaetes *Glycera* sp. (glycerid), *Aricidea philbinae*, and *A. cerrutii* (both paraonids) were dominants on one cruise but absent from all others. As noted for other middle and outer shelf stations, the orbiniid *Haploscoloplos* sp. was abundant in the Winter Cruise samples.

Macroepifauna -- The species collected in trawls at Station 12 were not predominantly characteristic of either sandy or live bottom habitats. A few invertebrate species typical of live bottom were collected in large numbers on the Fall Cruise, including galatheid crabs, *Munida* spp., which comprised 34% of all specimens collected, and the echinoderm *Stylocidaris affinis*. Among species typical of sandy habitats, the shrimp *Processa tenuipes* contributed 25% of all specimens collected and crabs, *Portunus* spp., were also abundant. The very sparse collections made on the Spring Cruise contained only 26 species of fishes and invertebrates, with three sponge species; most species collected were commonly associated with sandy substrata. The invertebrate collections made during the Summer Cruise revealed no pattern of substrate affinities. No sponge species were collected, and there were equal numbers of live and sandy bottom species. The species found during the Winter Cruise were somewhat different. Five species of sponges were collected, as were three species of ascidians, but more species were associated with sandy bottom, including penaeid shrimps, *Solenocera* sp., *Mesopenaeus* spp., *Portunus* spp., and *Squilla rugosa*, than with live bottom.

Table 7-19. Dominant taxa for Station 12, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Synelmis albini (P)	1	1	(+)	2
Glycera papillosa (P)	2	(-)	4	(-)
Fabricia sp. (P)	3	3	1	4
Aplacophora sp. A (S)	4	(+)	(+)	(+)
Aricidea simplex (P)	5	4	(-)	(+)
Notomastus hemipodus (P)	5	(+)	5	(+)
Sphenia tumida (Bi)	5	(-)	(-)	(-)
Glycera sp. (P)	(-)	2	(-)	(-)
Cirrophorus americanus (P)	(+)	4	(-)	(-)
Ampharetidae genus B (P)	(+)	5	3	3
Aricidea philbinae (P)	(-)	(-)	2	(-)
Aricidea cerrutii (P)	(-)	(-)	3	(-)
Aglaophamus verrilli (P)	(+)	(+)	3	(+)
Lumbrineris latreilli (P)	(-)	(+)	4	(-)
Mediomastus hartmanae (P)	(-)	(+)	5	(-)
Haploscoloplos sp. (P)	(+)	(-)	(-)	1
Sphaerosyllis sp. (P)	(+)	(+)	(+)	5

(Bi) = Bivalvia (+) = present but not among five most abundant
(P) = Polychaeta (-) = absent
(S) = Solenogaster-Mollusca

The dominant fish species from all cruises (Years One and Two) showed a preference toward sandy substrata: lizardfishes, Synodus spp. and Saurida spp.; flounders, Citharichthys spp.; and cusk eels, Lepophidium spp.

7.3.7 Station 14

Physical Features -- Station 14 was located at 25°46.01'N, 82°23.82'W; 72 km from shore. No general slope was apparent across the station block. However, occasional 0.3 to 0.9m depressions were observed. Depths ranged from 25.5 to 27m. Soft bottom substrates, consisting of fine sand, predominated at this site.

Taxonomic Richness & Composition -- Collections at Station 14 yielded 404 benthic taxa (Table 7-20). Most of these (84%) were infaunal. Groups having the highest number of taxa included Crustacea (37%), Annelida (polychaetes) (36%), Bivalvia (7%), Gastropoda (7%), and Gnathostomata (fishes) (5%). Collectively, these groups contributed 92% of all taxa.

Infaunal Abundance, Diversity, & Equitability -- Table 7-21 summarizes faunal density estimates and diversity and equitability values for box core data from Station 14. Faunal densities were high but exhibited no distinct seasonal pattern; values for the two Year Two cruises were higher than for the Year One cruises. Diversity and equitability values were more seasonally consistent, although Winter Cruise values were the lowest in each case. The values were in the mid range of diversities and equitabilities observed at soft bottom stations.

Dominant Infaunal Taxa -- Table 7-22 lists the most abundant taxa from box core data from Station 14. Ten of the 14 were polychaetes; the others were 2 amphipods and 2 bivalves. None of these taxa were dominants on all four cruises, and only the paraonid polychaete Aricidea fragilis was a dominant on three cruises. A high degree of seasonal variation in the dominant species was evident at this station.

Table 7-20. Soft bottom Station 14, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	2	2	2
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	7	7	7
CNIDARIA	0	0	0	0
ANNELIDA	146	0	0	146
GASTROPODA	28	1	1	29
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	0	0	0	0
BIVALVIA	30	0	0	30
SCAPHOPODA	2	0	0	2
CEPHALOPODA	0	1	1	1
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	127	25	24	151
SIPUNCULA	0	0	0	0
PRIAPULIDA	0	0	0	0
PHORONIDA	1	0	0	1
ECTOPROCTA	1	0	0	1
BRACHIOPODA	1	0	0	1
ECHINODERMATA	2	9	9	11
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	0	0	0
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	0	21	21	21
TOTAL	339	66	65	404

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-21. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 14.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	9,436	8,586	14,156	13,419	11,399	2,210 - 18,233
Diversity Index	1.61	1.58	1.62	1.54	1.59	1.13 - 1.97
Equitability	0.78	0.75	0.72	0.69	0.74	0.54 - 0.86

Table 7-22. Dominant taxa for Station 14, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Lucina radians (Bi)	1	2	(-)	(-)
Microdeutopus myersi (A)	2	(-)	(+)	(-)
Photis sp. A (A)	3	(+)	(-)	(-)
Magelona pettiboneae (P)	4	(+)	(+)	(+)
Grubeulepis cf. *mexicana* (P)	5	(-)	(-)	(-)
Prionospio cristata (P)	(+)	1	1	3
Aricidea fragilis (P)	(+)	3	5	2
Fabricia sp. (P)	(+)	4	3	(+)
Mediomastus californiensis (P)	(+)	5	(-)	(+)
Lucina muricata (Bi)	(+)	(-)	2	(-)
Mediomastus hartmanae (P)	(-)	(-)	4	(-)
Haplosyllis spongicola (P)	(-)	(-)	(+)	1
Lucina sp. (Bi)	(-)	(-)	(+)	4
Armandia maculata (P)	(+)	(+)	(+)	5

(Bi) = Bivalvia
(P) = Polychaeta
(A) = Amphipoda

(+) = present but not among five most abundant
(-) = absent

Macroepifauna -- Few species of either invertebrates or fishes were caught (less than 24) during any cruise except the Fall Cruise at Station 14. The more abundant invertebrate and fish species collected at this station were those associated with sandy habitats: penaeid shrimps, *Trachypenaeus constrictus*, *Sicyonia brevirostris*, *Solenocera* sp., and *Metapenaeopis goodei*; crabs, *Portunus* spp.; lizardfishes, *Synodus* spp.; flounders, *Bothus robinsi* and *Syacium papillosum*; and sand perch, *Diplectrum formosum*.

7.3.8 Station 16

Physical Features -- Station 16 was located at 25°45.70'N, 83°11.07'W; 149 km from shore. No general slope was apparent across the station block. However, occasional 0.3 to 0.6m depressions were observed. Depths ranged from 54 to 55m. Soft bottom substrates, consisting of medium to fine sands, predominated at this site.

Taxonomic Richness & Composition -- At Station 16, 602 taxa (identified to genus or species level) were collected by box core and otter trawl sampling, of which 66% were collected in the box cores (Table 7-23). Groups represented by the largest numbers of taxa include Annelida (polychaetes) (33%), Crustacea (31%), Gnathostomata (fishes) (10%), and Bivalvia (8%); these groups contributed 82% of the total taxa collected.

Infaunal Abundance, Diversity, & Equitability -- Table 7-24 summarizes faunal density estimates and diversity and equitability values for box core data from Station 16. Densities were low, and values for the Winter and Spring Cruises were higher than for the Summer and (especially) Fall Cruises. Diversity and equitability values were very high and the estimates for Fall and Summer Cruises were higher than for the Winter and Spring Cruises.

Dominant Infaunal Taxa -- Table 7-25 lists the most abundant taxa from the box core data from Station 16. Fourteen of the 15 taxa were polychaetes, the other being a bryozoan. Only the polychaetes *Synelmis albini* (pilargid) and *Prionospio cristata* (spionid) were dominants on three cruises. Although most taxa in

Table 7-23. Soft bottom Station 16, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	2	2	2
PHAEOPHYCOPHYTA	0	2	2	2
RHODOPHYCOPHYTA	0	1	1	1
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	32	32	32
CNIDARIA	0	0	0	0
ANNELIDA	198	0	0	198
GASTROPODA	16	20	20	36
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	1	0	0	1
BIVALVIA	41	8	6	47
SCAPHOPODA	4	0	0	4
CEPHALOPODA	0	3	3	3
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	132	60	55	187
SIPUNCULA	0	0	0	0
PRIAPULIDA	1	0	0	1
PHORONIDA	0	0	0	0
ECTOPROCTA	1	0	0	1
BRACHIOPODA	2	0	0	2
ECHINODERMATA	2	20	20	22
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	4	4	4
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	1	57	57	58
TOTAL	400	209	202	602

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-24. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 16.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	4,890	7,756	6,503	7,453	6,650	2,210 - 18,233
Diversity Index	1.88	1.75	1.93	1.72	1.82	1.13 - 1.97
Equitability	0.84	0.78	0.84	0.78	0.81	0.54 - 0.86

Table 7-25. Dominant taxa for Station 16, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Synelmis albini (P)	1	3	(+)	3
Lysippe cf. annectens (P)	2	(+)	(+)	(+)
Prionospio cristata (P)	3	1	2	(+)
Magelona sp. A (P)	4	(+)	(+)	(+)
Notomastus hemipodus (P)	5	(+)	(+)	(+)
Ampharetidae genus B (P)	(-)	2	1	(+)
Prionospio cirrifera (P)	(+)	4	(+)	(+)
Selenaria sp. (B)	(+)	5	(+)	(+)
Aglaophamus verrilli (P)	(+)	(+)	3	(+)
Aricidea catherinae (P)	(+)	(+)	4	(+)
Fabricia sp. (P)	(+)	(+)	5	(+)
Haplosyllis spongicola (P)	(-)	(+)	(+)	1
Haploscoloplos sp. (P)	(-)	(-)	(-)	2
Palaenotus sp. A (P)	(+)	(+)	(+)	4
Notomastus americanus (P)	(-)	(+)	(-)	5

(P) = Polychaeta (+) = present but not among five most abundant
(B) = Bryozoa (-) = absent

the table were dominant on only one cruise, most of these were at least present in the other cruise samples.

Macroepifauna -- The majority of the fauna from all cruises at Station 16 is typical of that found in thick live bottom areas. More species of fishes and invertebrates were found at this station than at any other (69 on the Fall Cruise, 95 on the Spring Cruise, 90 on the Summer Cruise, and 99 on the Winter Cruise).

Some of the more motile species are typical of sparse, sandy habitats: penaeid shrimps, *Metapenaeopsis goodei*, *Sicyonia* spp., and *Solenocera atlantidis*; crabs, *Portunus* spp.; processid shrimps, *Processa* spp.; lizardfishes, *Synodus* spp.; flounders, *Syacium papillosum* and *Bothus* spp.; and filefishes, *Monacanthus* spp. Most of the invertebrate and fish species, though, are more typically associated with the rich live bottom. Many live bottom species of crabs (*Stenorhynchus* spp., *Stenocionops* spp., *Collodes trispinosus*, and *Iliacantha* spp.), molluscs (*Murex* spp., *Octopus* spp., *Lima* spp., and *Vermicularia knorrii*), shrimps (*Stenopus* spp., *Synalpheus* spp., *Alpheus* spp., and *Lysmata* spp.), reptantian crustaceans (*Scyllarus* spp., *Scyllarides nodifer*, and *Munida* spp.), and echinoderms (*Diadema antillarum*, *Arbacia punctulata*, *Eucidaris* sp., and *Stylocidaris* spp.) prefer habitats which provide good shelter and food.

Live bottom fishes were well represented in trawl collections: scorpionfishes, *Scorpaena* spp,; sea basses, *Centropristis* spp. and *Serranus* spp.; sea horse, *Hippocampus erectus*; eel, *Gymnothorax saxicola*; parrotfishes, *Cryptotomus roseus* and *Nicholsina usta*; and the cardinalfishes, *Apogon* spp.

7.3.9 Station 18

Physical Features -- Station 18 was located at 25°45.37'N, 83°42.22'W; 183 km from shore. Across the station block, there was a general downward slope from east to west, depths ranging from 84 to 90m. Slopes were gradual in the northern portions of the station, but much more abrupt in the southern areas.

Soft bottom substrates, composed of medium sand, predominated at this location.

Taxonomic Richness & Composition -- Benthic biological collections from two cruises yielded 286 taxa (identified to genus or species) at Station 18 (Table 7-26). Approximately 81% of these were infaunal organisms. Five major groups accounted for 92% of all taxa identified at this location. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (42%), Crustacea (33%), Gnathostomata (fishes) (7%), Gastropoda (6%), and Bivalvia (4%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-27 summarizes faunal density estimates and diversity and equitability values for box core data from Station 18. Faunal densities were low, with the Spring Cruise values being somewhat higher than those for the Fall Cruise. Diversity values were in the mid range of values observed, with the Spring Cruise values higher than those of the Fall Cruise. Equitability values were also moderate but showed no between-cruise variation.

Dominant Infaunal Taxa -- Table 7-28 lists the most abundant taxa from box core data from Station 18. Seven of the nine taxa were polychaetes, the others being an amphipod and a brachiopod. The pilargid polychaete *Synelmis albini* was most abundant on both cruises. Four of the others were abundant on one cruise and absent from the other, indicating a moderate degree of between-cruise variation in the abundance of dominants.

Macroepifauna -- Although a few typical live bottom or reef species were collected (*Stylocidaris affinis*, *Stenorhynchus* spp., *Gymnothorax saxicola*, and *Scorpaena brasiliensis*), most species were characteristic of sandy bottom (penaeid shrimps, *Sicyonia brevirostris*, *Solenocera* spp., and *Mesopenaeus tropicalis*; processid shrimp, *Processa tenuipes*; lizardfishes, *Synodus* spp. and *Saurida* sp.; sea robins, *Bellator* spp. and *Prionotus* spp.; flounders, *Syacium papillosum*, *Citharichthys gymnorhinus*; and filefish, *Monacanthus ciliatus*).

Table 7-26. Soft bottom Station 18, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	1	1	1
PHAEOPHYCOPHYTA	0	1	1	1
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	2	2	2
CNIDARIA	1	0	0	1
ANNELIDA	119	0	0	119
GASTROPODA	13	5	5	18
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	2	0	0	2
BIVALVIA	10	1	1	11
SCAPHOPODA	2	0	0	2
CEPHALOPODA	0	0	0	0
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	76	19	19	95
SIPUNCULA	4	0	0	4
PRIAPULIDA	0	0	0	0
PHORONIDA	1	0	0	1
ECTOPROCTA	1	0	0	1
BRACHIOPODA	2	0	0	2
ECHINODERMATA	1	3	3	4
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	1	1	1
CHORDATA-CEPHALOCHORDATA	0	0	0	0
CHORDATA-GNATHOSTOMATA	0	21	21	21
TOTAL	232	54	54	286

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-27. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 18.

Parameter	Cruise*				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	3,817	4,930	-	-	4,373	2,210 - 18,233
Diversity Index	1.54	1.63	-	-	1.58	1.13 - 1.97
Equitability	0.74	0.74	-	-	0.74	0.54 - 0.86

*Station 18 was not sampled on the Year Two (Summer and Winter) Cruises.

Table 7-28. Dominant taxa for Station 18, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise*	
	Fall	Spring
Synelmis albini (P)	1	1
Glottidia pyramidata (Br)	2	(-)
Lysippe cf. annectens (P)	3	(-)
Aricidea simplex (P)	4	(+)
Glycera papillosa (P)	5	(+)
Prionospio cirrobranchiata (P)	(-)	2
Sphaerosyllis sp. (P)	(+)	3
Cirrophorus americanus (P)	(+)	4
Ampelisca agassizi (A)	(-)	5

(P) = Polychaeta (+) present but not among the five most abundant
(Br) = Brachiopoda (-) = absent
(A) = Amphipoda

*Station 18 was not sampled on the Year Two (Summer and Winter) Cruises.

7.3.10 Station 20

Physical Features -- Station 20 was located at 25°17.34'N, 82°09.73'W; 39 km from shore. No general slope was apparent across the station block. However, occasional 0.3 to 0.6m depressions were observed. Depths ranged from 22 to 23m. Soft bottom substrates, consisting of medium to coarse sand, predominated at this site.

Taxonomic Richness & Composition -- Benthic biological collections yielded 429 taxa (identified to genus or species) at Station 20 (Table 7-29). Approximately 83% of these were infaunal organisms. Five major groups accounted for 94% of all taxa identified at this site. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (40%), Crustacea (35%), Bivalvia (8%), Gnathostomata (fishes) (6%), and Gastropoda (5%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-30 summarizes faunal density estimates and diversity and equitability values for box core data from Station 20. Faunal densities were among the higher values observed, and the estimates increased monotonically from the Fall (first) to Winter (last) Cruise with no discernable seasonal pattern. Diversity values were among the highest observed and were highest on the Summer Cruise. Equitability values were, on the average, the highest of any station; little between-cruise variation was evident.

Dominant Infaunal Taxa -- Table 7-31 lists the most abundant taxa from box core data from Station 20. Twelve of the 17 taxa were polychaetes, the others being two amphipods, a tanaid, a cumacean, and a bryozoan. There was a high degree of seasonal variation in the identity of the dominants; only three polychaetes (the paraonid *Cirrophorus americanus*, the spionid *Prionospio cristata*, and the syllid *Pionosyllis gesae*) were among the dominants on more than one cruise. The amphipod *Lembos* sp. A was abundant on the Fall Cruise but not present in subsequent cruise samples.

Macroepifauna -- Station 20 was one of the three stations with the lowest species richness (only 25 species total). Few species and numbers of both

Table 7-29. Soft bottom Station 20, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	10	10	10
CNIDARIA	1	0	0	1
ANNELIDA	170	0	0	170
GASTROPODA	19	1	1	20
POLYPLACOPHORA	1	0	0	1
APLACOPHORA	0	0	0	0
BIVALVIA	34	1	1	35
SCAPHOPODA	0	0	0	0
CEPHALOPODA	0	2	2	2
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	122	30	29	151
SIPUNCULA	1	0	0	1
PRIAPULIDA	1	0	0	1
PHORONIDA	1	0	0	1
ECTOPROCTA	1	0	0	1
BRACHIOPODA	1	0	0	1
ECHINODERMATA	1	7	6	7
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	1	1	1
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	0	25	25	25
TOTAL	354	77	75	429

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-30. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 20.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	6,516	8,246	8,343	10,566	8,418	2,210 - 18,233
Diversity Index	1.71	1.77	1.88	1.78	1.78	1.13 - 1.97
Equitability	0.83	0.82	0.83	0.80	0.82	0.54 - 0.86

Table 7-31. Dominant taxa for Station 20, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Lembos sp. A (A)	1	(-)	(-)	(-)
Kalliapseudes sp. A (T)	2	(-)	(+)	(+)
Cirrophorus americanus (P)	3	1	(-)	(-)
Microdeutopus myersi (A)	4	(+)	(+)	(-)
Selenaria sp. (B)	5	(+)	(+)	(+)
Prionospio cristata (P)	(+)	2	(+)	5
Fabricia sp. (P)	(+)	3	(+)	(+)
Ancistrosyllis hartmane (P)	(+)	4	(+)	(+)
Pionosyllis gesae (P)	(+)	5	(+)	3
Cirrophorus branchiatus (P)	(+)	(+)	1	(+)
Heteropodarke heteromorpha (P)	(-)	(+)	2	(+)
Leptochelia sp. A (C)	(+)	(-)	3	(+)
Sphaerosyllis sp. (P)	(+)	(+)	4	(+)
Eunice vittata (P)	(+)	(-)	5	(+)
Haplosyllis spongicola (P)	(-)	(+)	(+)	1
Haploscoloplos sp. (P)	(-)	(-)	(+)	2
Cirrophorus lyra (P)	(-)	(-)	(+)	4

(A) = Amphipoda
(C) = Caridea
(B) = Bryozoa
(P) = Polychaete
(T) = Tanaidacea
(+) = present but not among five most abundant
(-) = absent

fishes and invertebrates were collected. The majority of these species do not show high affinities for either sandy or live bottom habitat. Sponges were one of the more abundant groups sampled during the Spring, Summer, and Winter Cruises. The most abundant invertebrates from all four collections were portunid crabs, *Portunus* spp., and commercial penaeid shrimps, *Penaeus aztecus* and *Sicyonia brevirostris*. The more abundant fish species included: sand perches, *Diplectrum* spp.; snakefish, *Trachinocephalus myops*; and filefishes, *Monacanthus* spp. All of these dominant invertebrate and fish species prefer a sandy/shell habitat.

7.3.11 Station 22

Physical Features -- Station 22 was located at 25°17.18'N, 83°02.07'W; 154 km from shore. Depths across the station ranged from 52 to 53.5m, but no general slopes or irregular features were observed. Soft bottom substrates, composed of medium to fine sand, predominated.

Taxonomic Richness & Composition -- Benthic biological collections yielded 544 taxa (identified to genus or species) at Station 22 (Table 7-32). Most (69%) of these were infaunal organisms. Six major groups contributed 94% of all taxa identified at this location. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (33%), Crustacea (31%), Gnathostomata (fishes) (10%), Bivalvia (8%), Porifera (6%), and Gastropoda (6%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-33 summarizes faunal density estimates and diversity and equitability values for box core data from Station 22. Faunal density was moderately high and showed pronounced between-cruise variation; the Spring and Summer Cruise values were higher than those for the Fall and Winter Cruises, indicating a possible seasonal abundance pattern. Diversity values were also moderately high, with the maximum reached on the Summer Cruise and the minimum on the Winter Cruise. Equitability values showed little seasonal variation and were moderately high.

Dominant Infaunal Taxa -- Table 7-34 lists the most abundant taxa from the box cores at Station 22. Fourteen of the 15 taxa were polychaetes, the other being

Table 7-32. Soft bottom Station 22, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	1	1	1
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	32	32	32
CNIDARIA	1	0	0	1
ANNELIDA	177	0	0	177
GASTROPODA	23	9	8	31
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	1	0	0	1
BIVALVIA	39	6	6	45
SCAPHOPODA	2	0	0	2
CEPHALOPODA	0	4	4	4
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	125	50	46	171
SIPUNCULA	0	0	0	0
PRIAPULIDA	1	0	0	1
PHORONIDA	1	0	0	1
ECTOPROCTA	1	0	0	1
BRACHIOPODA	1	0	0	1
ECHINODERMATA	4	12	11	15
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	6	6	6
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	1	52	52	53
TOTAL	378	172	166	544

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-33. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 22.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	6,770	9,083	10,652	6,063	8,142	2,210 - 18,233
Diversity Index	1.73	1.74	1.81	1.64	1.73	1.13 - 1.97
Equitability	0.78	0.77	0.80	0.77	0.78	0.54 - 0.86

Table 7-34. Dominant taxa for Station 22, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Synelmis albini (P)	1	2	5	(+)
Aricidea catherinae (P)	2	5	(-)	2
Lucina radians (Bi)	3	(-)	(-)	(-)
Aricidea wassi (P)	4	(-)	(-)	(+)
Lysippe cf. annectens (P)	5	(-)	(+)	(-)
Mediomastus californiensis (P)	5	(+)	(-)	(+)
Ampharetidae genus B (P)	(+)	1	1	(+)
Prionospio cristata (P)	(-)	3	2	(-)
Fabricia sp. (P)	(+)	4	(+)	(+)
Aricidea fragilis (P)	(-)	(-)	3	(-)
Filograna implexa (P)	(-)	(-)	4	(-)
Haploscoloplos sp. (P)	(-)	(+)	(-)	1
Aricidea cf. suecica (P)	(+)	(-)	(-)	3
Aglaophamus verrilli (P)	(+)	(+)	(-)	4
Ceratocephale oculata (P)	(+)	(+)	(+)	5

(P) = Polychaeta (+) = present but not among five most abundant
(Bi) = Bivalvia (-) = absent

the bivalve Lucina radians. The pilargid polychaete Synelmis albini was the only taxon among the dominants for three cruises; Ampharetidae genus B was the most abundant taxon on two cruises and was at least present on the other two. Twelve taxa were dominants on only one cruise, indicating a high degree of seasonal variation in the abundance of dominant taxa at Station 22. As at several other stations, the orbiniid Haploscoloplos sp. was highly abundant in the Winter Cruise samples.

Macroepifauna -- The epifauna at Station 22, like that at Station 16, can be characterized as typical of live bottom habitat. A large number of sponge species (8 to 19) were collected from each cruise. Most of the other invertebrate species collected are typical of live bottom habitats and include: molluscs, Chlamys benedicti, Lima pellucida, Octopus spp., Turritella spp., and Vermicularia knorii; crustaceans, Scyllarus spp., Stenopus spp., Pilumnus floridanus, Stenocionops furcata coelata, Stenorhynchus seticornis, and Dromidia antillensis; echinoderms, Eucidaris tribuloides and Arbacia punctulata; and ascidians, Polycarpa spp. and Clavelina spp.

The only invertebrates collected which occurred preferentially on sandy bottom were the penaeid shrimps, Metapenaeopsis goodei, Sicyonia brevirostris, and Solenocera atlantidis.

A majority of the fish species were also live bottom or reef dwellers, including: moray eel, Gymnothorax saxicola; scorpionfishes, Scorpaena spp.; sea basses, Centropristis spp.; soapfishes, Rypticus spp.; sea horses, Hippocampus spp.; Chromis, Chromis spp.; butterflyfish, Chaetodon sedentarius; and frogfish, Antennarius ocellatus. The other dominant fish species collected were those normally inhabiting sandy substrates: flounders, Bothus robinsi, Syacium papillosum, and Cyclopsetta fimbriata; and filefishes, Monacanthus spp.

7.3.12 Station 24

Physical Features -- Station 24 was located at 25°16.90'N, 83°43.18'W; 217 km from shore. Across the station block, there was a general downward slope from east to west. Depths ranged from 87 to 90m. Soft bottom substrates, composed of medium sand, predominated.

Taxonomic Richness & Composition -- Benthic biological collections yielded 484 taxa (identified to genus or species) at Station 24 (Table 7-35). Approximately 72% of these were infaunal organisms. Six major groups contributed 94% of all taxa identified at this location. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (38%), Crustacea (30%), Gnathostomata (fishes) (9%), Bivalvia (7%), Gastropoda (6%), and Echinodermata (4%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-36 summarizes faunal density estimates and diversity and equitability values for box core data from Station 24. Faunal densities were very low on the Fall and Spring Cruises but moderately high on the Summer and Winter Cruises, so no seasonal pattern is apparent. Diversity values exhibited the opposite pattern (higher in fall and spring) and were in the mid range of values observed. Equitability values were moderately high, with the Summer Cruise value slightly lower than the others.

Dominant Infaunal Taxa -- Table 7-37 lists the most abundant taxa from box cores at Station 24. Eleven of the 17 taxa were polychaetes, two were amphipods, two were bivalves, one was a brachiopod, and one a solenogaster (mollusc). The pilargid polychaete *Synelmis albini* was consistently first or second in abundance, but most of the other taxa were among the dominants on only one cruise. Three taxa (the paraonid polychaete *Levinsenia reducta* and the bivalves *Diplodonta* sp. and *Laevicardium* sp.) were among the dominants on one cruise but absent from all others. These results suggest a high level of between-cruise variation in the abundance of the dominants.

Macroepifauna -- The trawl collections made at Stations 24 included mostly species typical of sandy substrate. Only five species of sponges and three of ascidians and a few other live bottom species were collected from all four cruises.

A majority of dominant fish and invertebrate species collected were those commonly found in soft bottom habitats, including: penaeid shrimps, *Penaeus*

Table 7-35. Soft bottom Station 24, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	1	1	1
PHAEOPHYCOPHYTA	0	1	1	1
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	5	5	5
CNIDARIA	0	0	0	0
ANNELIDA	183	0	0	183
GASTROPODA	18	14	13	31
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	3	0	0	3
BIVALVIA	30	2	2	32
SCAPHOPODA	6	0	0	6
CEPHALOPODA	0	4	4	4
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	101	47	44	145
SIPUNCULA	1	0	0	1
PRIAPULIDA	1	0	0	1
PHORONIDA	0	0	0	0
ECTOPROCTA	1	0	0	1
BRACHIOPODA	2	0	0	2
ECHINODERMATA	3	17	17	20
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	3	3	3
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	0	44	44	44
TOTAL	350	138	134	484

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-36. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 24.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	3,780	4,170	7,970	9,083	6,251	2,210 - 18,233
Diversity Index	1.63	1.66	1.54	1.53	1.59	1.13 - 1.97
Equitability	0.78	0.76	0.69	0.74	0.74	0.54 - 0.86

Table 7-37. Dominant taxa for Station 24, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Synelmis albini (P)	1	1	2	1
Platidia clepsydra (Br)	2	3	(+)	(+)
Hippomedon sp. A (A)	2	(+)	(+)	(-)
Aplacophora sp. B (S)	3	(-)	(+)	(+)
Lumbrineris latreilli (P)	4	(+)	(+)	(+)
Cirrophorus americanus (P)	5	(+)	(-)	(-)
Levinsenia reducta (P)	5	(-)	(-)	(-)
Sphaerosyllis sp. (P)	(+)	2	(+)	(+)
Typosyllis cf. lutea (P)	(-)	4	(-)	(+)
Prionospio cirrobranchiata (P)	(+)	5	(+)	4
Filograna implexa (P)	(-)	(-)	1	(+)
Haplosyllis spongicola (P)	(-)	(+)	3	(+)
Diplodonta sp. (Bi)	(-)	(-)	4	(-)
Lembos sp. (A)	(-)	(+)	5	(-)
Haploscoloplos sp. (P)	(-)	(+)	(-)	2
Laevicardium sp. (Bi)	(-)	(-)	(-)	3
Levinsenia gracilis (P)	(+)	(+)	(-)	5

(P) = Polychaeta
(Br) = Brachiopoda
(A) = Amphipoda
(Bi) = Bivalvia
(S) = Solenogaster-Mollusca
(+) = present but not among five most abundant
(-) = absent

duorarum, Sicyonia brevirostris, Mesopenaeus tropicalis, and Solenocera atlantidis; processid shrimp, Processa tenuipes; crabs, Portunus spp.; mantis shrimps, Squilla spp.; lizardfishes, Synodus spp. and Saurida normani; flounders, Citharichthys spp. and Syacium papillosum; sea robins, Bellator militaris and Prionotus spp.; sand perch, Diplectrum bivittatum; and cusk eel, Lepophidium sp.

7.3.13 Station 25

Physical Features -- Station 25 was located at 24°47.95'N, 82°13.26'W; 118 km from shore. Across the station there was a slight downward slope from south to north, depths ranging from 23 to 24m. Bottom substrates consisted of silt/ clay sediment.

Taxonomic Richness & Composition -- Benthic biological collections yielded 269 taxa (identified to genus or species) at Station 25 (Table 7-38). Most of these (74%) were infaunal organisms. Five major groups contributed 91% of all taxa identified at this site. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (38%), Crustacea (30%), Gnathostomata (fishes) (10%), Bivalvia (8%), and Gastropoda (5%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-39 summarizes faunal density estimates and diversity and equitability values for box core data from Station 25. Faunal densities were relatively low on the Fall and Winter Cruises but moderately high on the Spring and Summer Cruises, indicating a possible seasonal abundance pattern. Diversity values were very low and followed a similar pattern. Equitability values were moderately low and varied little between cruises.

Dominant Infaunal Taxa -- Table 7-40 lists the most abundant taxa from the box cores at Station 25. Eight of the nine taxa were polychaetes, and three of these (the spionids Prionospio cirrifera and P. cristata, and the magelonid Magelona pettiboneae) were dominants for all cruises. Only the gregarious serpulid polychaete Filograna implexa and the bivalve Tellina sybaritica were dominants on a particular cruise but absent on all others.

Table 7-38. Soft bottom Station 25, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major taxonomic groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	5	5	5
CNIDARIA	1	0	0	1
ANNELIDA	101	0	0	101
GASTROPODA	12	2	2	14
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	1	0	0	1
BIVALVIA	22	0	0	22
SCAPHOPODA	2	0	0	2
CEPHALOPODA	0	2	2	2
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	54	29	28	82
SIPUNCULA	0	0	0	0
PRIAPULIDA	1	0	0	1
PHORONIDA	2	0	0	2
ECTOPROCTA	0	0	0	0
BRACHIOPODA	1	0	0	1
ECHINODERMATA	2	2	2	4
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	3	3	3
CHORDATA-CEPHALOCHORDATA	0	0	0	0
CHORDATA-GNATHOSTOMATA	0	28	28	28
TOTAL	199	71	70	269

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-39. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 25.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	6,203	9,776	7,496	4,223	6,925	2,210 - 18,233
Diversity Index	1.31	1.38	1.42	1.28	1.35	1.13 - 1.97
Equitability	0.72	0.71	0.69	0.74	0.72	0.54 - 0.86

Table 7-40. Dominant taxa for Station 25, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Prionospio cirrifera (P)	1	4	2	1
Prionospio cristata (P)	2	1	1	2
Magelona pettiboneae (P)	3	3	4	3
Mediomastus californiensis (P)	4	(+)	(-)	4
Magelona cf. cincta (P)	5	(+)	(+)	(+)
Paraprionospio pinnata (P)	(+)	2	(+)	(+)
Tellina sybaritica (Bi)	(-)	5	(-)	(-)
Filograna implexa (P)	(-)	(-)	3	(-)
Synelmis albini (P)	(+)	(+)	5	5

(P) = Polychaeta (+) = present but not among five most abundant
(Bi) = Bivalvia (-) = absent

Macroepifauna -- All of the dominant taxa of fishes and invertebrates collected are typically associated with sandy habitats. The station was located within the Tortugas pink shrimp grounds, and the seven invertebrate species that made up over 50% of all invertebrates collected included penaeid shrimps, *Penaeus duorarum*, *Sicyonia* spp., and *Trachypenaeus constrictus*; crabs, *Portunus* spp.; and mantis shrimp, *Squilla empusa*.

Almost all of the fish species collected are normally found inhabiting sandy bottoms. The most abundant were: sand perches, *Diplectrum* spp.; Atlantic bumper, *Chloroscombrus chrysurus*; pinfish, *Lagodon rhomboides*; flounders, *Etropus crossotus*, *Syacium* spp., and *Bothus ocellatus*; and lizardfishes, *Synodus* spp. and *Saurida brasiliensis*.

7.3.14 Station 26

Physical Features -- Station 26 was located at 24°47.82'N, 82°52.07'W; 176 km from shore. Across the station, a slight downward slope was discernible from east to west. Depths ranged from 37.5 to 38.5m. Substrates at this location consisted of silt/clay sediments.

Taxonomic Richness & Composition -- Benthic biological collections from two cruises yielded 213 taxa (identified to genus or species) at Station 26 (Table 7-41). Approximately 69% of these were infaunal. Five major groups contributed 94% of all taxa identified at this location. Listed in order of decreasing numbers of taxa, these groups were Crustacea (38%), Annelida (polychaetes) (29%), Gnathostomata (fishes) (12%), Bivalvia (10%), and Gastropoda (5%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-42 summarizes faunal density estimates and diversity and equitability values for box core data from Station 26. Faunal densities were, on the average, in the mid range of values observed, but the Spring Cruise values were nearly twice those for the Fall Cruise. Diversity values were low and followed a similar pattern (higher on the Spring Cruise). Equitability values were in the mid range of those observed, and varied little between cruises.

Table 7-41. Soft bottom Station 26, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	3	3	3
CNIDARIA	0	0	0	0
ANNELIDA	61	0	0	61
GASTROPODA	9	1	1	10
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	1	0	0	1
BIVALVIA	17	8	5	22
SCAPHOPODA	2	0	0	2
CEPHALOPODA	0	1	1	1
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	53	30	29	82
SIPUNCULA	0	0	0	0
PRIAPULIDA	0	0	0	0
PHORONIDA	1	0	0	1
ECTOPROCTA	0	0	0	0
BRACHIOPODA	1	0	0	1
ECHINODERMATA	0	4	4	4
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	0	0	0
CHORDATA-CEPHALOCHORDATA	0	0	0	0
CHORDATA-GNATHOSTOMATA	1	24	24	25
TOTAL	146	69	67	213

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-42. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 26.

Parameter	Cruise*				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	5,270	9,553	-	-	7,411	2,210 - 18,233
Diversity Index	1.35	1.54	-	-	1.44	1.13 - 1.97
Equitability	0.73	0.76	-	-	0.74	0.54 - 0.86

*Station 26 was not sampled on the Year Two (Summer and Winter) Cruises.

Dominant Infaunal Taxa -- Table 7-43 lists the most abundant taxa from box core data from Station 26. Five of the eight taxa were polychaetes, two were bivalves, and one was a gastropod. Only the pilargid polychaete *Sigambra tentaculata* and the bivalve *Lucina radians* were dominants on both cruises.

Macroepifauna -- The invertebrate epifauna at Station 26 was rich in species associated with sandy habitats and included: penaeid shrimps (*Penaeus duorarum*, *Sicyonia* spp., *Solenocera atlantidis*, and *Trachypenaeus* spp.), which composed more than 50% of the total number of invertebrates present during both cruises (Station 26 is also located within the Tortugas pink shimp grounds); calico scallop, *Argopecten gibbus*, commonly found on sand/shell bottoms; and portunid crabs, *Portunus* spp. The dominant fish species caught were those normally found on sand/shell or muddy bottom and included: jawfish, *Lonchopisthus micrognathus*; cusk eel, *Lepophidium graellsi*; gobies, *Gobiosoma longipalpa* (82% of total number of fishes from the Spring Cruise) and *Bollmannia communis*; midshipman, *Porichthys plectrodon*; and flounders, *Syacium* spp.

7.3.15 Station 28

Physical Features -- Station 28 was located at 24°47.11'N, 83°13.08'W; 200 km from shore. No general slope was apparent across the station; depths ranged from 58.5 to 59m. Soft bottom substrates consisting of fine sand predominated at this site. A few small rock outcrops were also observed.

Taxonomic Richness & Composition -- Benthic biological collections yielded 558 taxa (identified to genus or species) at Station 28 (Table 7-44). Most of these (72%) were infaunal organisms. Six major groups contributed 93% of all taxa identified at this location. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (32%), Crustacea (32%), Gnathostomata (fishes) (9%), Bivalvia (9%), Gastropoda (6%), and Porifera (5%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-45 summarizes faunal density estimates and diversity and equitability values from the box core data at Station 28. Faunal density was moderately high and varied significantly between cruises, but with no apparent seasonal pattern; the two Year Two esti-

Table 7-43. Dominant taxa for Station 26, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise*	
	Fall	Spring
Caecum pulchellum (G)	1	(-)
Sigambra tentaculata (P)	2	2
Prionospio cirrifera (P)	3	(+)
Lucina radians (Bi)	4	4
Mediomastus californiensis (P)	5	(+)
Prionospio cristata (P)	(+)	1
Sphaerosyllis sp. (P)	(+)	3
Lyonsia hyalina floridana (Bi)	(-)	5

(G) = Gastropoda
(Bi) = Bivalvia
(P) = Polychaeta

(+) present but not among the five most abundant
(-) = absent

*Station 26 was not sampled on the Year Two (Summer and Winter) Cruises.

Table 7-44. Soft bottom Station 28, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	2	2	2
PHAEOPHYCOPHYTA	0	1	1	1
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	26	26	26
CNIDARIA	0	0	0	0
ANNELIDA	181	0	0	181
GASTROPODA	22	9	9	31
POLYPLACOPHORA	1	0	0	1
APLACOPHORA	1	0	0	1
BIVALVIA	44	9	6	50
SCAPHOPODA	3	0	0	3
CEPHALOPODA	0	5	5	5
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	144	42	37	181
SIPUNCULA	0	0	0	0
PRIAPULIDA	1	0	0	1
PHORONIDA	0	0	0	0
ECTOPROCTA	1	0	0	1
BRACHIOPODA	1	0	0	1
ECHINODERMATA	3	13	12	15
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	1	3	3	4
CHORDATA-CEPHALOCHORDATA	1	0	0	1
CHORDATA-GNATHOSTOMATA	0	53	53	53
TOTAL	404	163	154	558

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-45. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 28.

Parameter	Cruise				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	6,676	6,923	10,283	8,280	8,040	2,210 - 18,233
Diversity Index	1.90	1.97	1.67	1.63	1.79	1.13 - 1.97
Equitability	0.84	0.86	0.71	0.76	0.79	0.54 - 0.86

mates were higher than those for the Year One cruises. Diversity values were among the highest observed during this study; no seasonal pattern was evident, with the Year Two estimates being higher than those for Year One cruises. Equitability values, in contrast, were higher on the two Year One cruises, but again no seasonal pattern was evident.

Dominant Infaunal Taxa -- Table 7-46 lists the most abundant taxa from box core data from each cruise; the list includes nine polychaetes, two bivalves, two amphipods, and one priapulid. Only the polychaete Ampharetidae genus B was among the most abundant taxa for several cruises (three). Most other taxa in the table were among the most abundant taxa for only one cruise, suggesting a high degree of seasonal variation. The orbiniid polychaete *Haploscoloplos* sp. was highly abundant in Winter Cruise samples.

Macroepifauna -- The specimens collected from Station 28, like those at Stations 16 and 22, were typical of fauna associated with live bottom areas. Samples from the Year One cruises had more sponge species and associated fauna (Fall Cruise--15 sponge species; Spring Cruise--12 sponge species) than did those from the Year Two cruises (Summer Cruise--0 sponge species; Winter Cruise--6 sponge species). The common live bottom or reef dwelling invertebrates collected were octopi, *Octopus* spp.; cleaner shrimps, *Stenopus* spp.; spider crabs, *Stenocionops furcata* and *Stenorhynchus seticornis*; xanthid crab, *Pilumnus floridanus*; echinoderms, *Ophiothrix* spp., *Stylocidaris affinis*, and *Eucidaris tribuloides*; ascidians, *Polycarpa obtecta*, *Clavelina gigantea*, and *Aplidium* sp.; and molluscs, *Calliostoma* spp., *Vermicularia knorrii*, and *Diodora listeri*. A larger number of abundant shrimp species associated with sand habitats were collected during the Fall Cruise. These species, consisting of the penaeid shrimps, *Penaeus duorarum*, *Trachypenaeus* sp., *Metapenaeopsis goodei*, *Sicyonia brevirostris*, and *Solenocera* spp.; and the caridean shrimps, *Nikoides schmitti* and *Processa* spp., make up more than 76% of the total number of invertebrates collected. The other three cruises had fairly equal numbers of less abundant invertebrate species which are common on both live and sand bottom habitats.

Table 7-46. Dominant taxa for Station 28, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise			
	Fall	Spring	Summer	Winter
Synelmis albini (P)	1	4	(+)	(+)
Lysippe cf. annectens (P)	2	(+)	(+)	(-)
Lucina radians (Bi)	3	2	(-)	(-)
Magelona sp. A (P)	4	5	(+)	(+)
Tubiluchus corallicola (Pr)	5	(+)	(+)	(-)
Ampharetidae genus B (P)	(-)	1	2	4
Maera cf. caroliniana (A)	(-)	3	(+)	(-)
Filograna implexa (P)	(-)	(-)	1	(-)
Lucina sp. (Bi)	(-)	(-)	3	(+)
Ampelisca agassizi (A)	(-)	(+)	4	(-)
Aglaophamus verrilli (P)	(+)	(-)	5	3
Haploscoloplos sp. (P)	(-)	(-)	(-)	1
Palaenotus sp. A (P)	(+)	(+)	(+)	2
Levinsenia gracilis (P)	(-)	(+)	(-)	5

(P) = Polychaeta
(Bi) = Bivalvia
(A) = Amphipoda
(Pr) = Priapulida
(+) = present but not among five most abundant
(-) = absent

The majority of the fish species also showed affinities toward one or the other type of habitat. The sand bottom species were dominated by sea robins, *Bellator militaris* and *Prionotus* spp.; flounders, *Syacium papillosum*, *Bothus robinis*, and *Citharichthys gymnorhinus*; lizardfishes, *Synodus* spp. and *Saurida brasiliensis*; and filefishes, *Monacanthus* spp. Reef associates were also very common, and included: cardinalfishes, *Apogon* spp.; sea basses, *Centropristis* spp.; frogfishes, *Antennarius* spp.; soapfishes, *Rypticus* spp.; and moray eel, *Gymnothorax saxicola*.

7.3.16 Station 31

Physical Features -- Station 31 was located at 26°45.61'N, 84°14.81'W; 183 km from shore. Across the station, there was a general downward slope from ENE to WSW. Depths ranged from 139 to 143m. Fine sand sediments were the characteristic substrate at this site.

Taxonomic Richness & Composition -- Benthic biological collections yielded 207 taxa (identified to genus or species) at Station 31 (Table 7-47). Approximately 77% of these were infaunal organisms. Four major groups contributed 94% of all taxa taken at this station. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (46%), Crustacea (31%), Gnathostomata (fishes) (11%), and Bivalvia (6%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-48 summarizes faunal density estimates and diversity and equitability values for Station 31. Faunal density values were among the lowest observed at any station and exhibited little variation between the two seasonal samples. Diversity values were also among the lowest observed and were lower during the Winter than the Summer Cruise. Equitability values were moderately high and exhibited little variation between the sampling dates.

Dominant Infaunal Taxa -- Table 7-49 lists the most abundant taxa from the box core data from Station 31 for each of the two cruises. Six of the seven taxa were polychaetes, and most of these taxa were abundant on both cruises, indi-

Table 7-47. Soft bottom Station 31, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	0	0	0
CNIDARIA	0	0	0	0
ANNELIDA	96	0	0	96
GASTROPODA	2	1	1	3
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	3	0	0	3
BIVALVIA	11	2	2	13
SCAPHOPODA	2	0	0	2
CEPHALOPODA	0	1	1	1
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	46	20	18	64
SIPUNCULA	0	0	0	0
PRIAPULIDA	0	0	0	0
PHORONIDA	0	0	0	0
ECTOPROCTA	0	0	0	0
BRACHIOPODA	0	0	0	0
ECHINODERMATA	0	2	2	2
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	0	0	0
CHORDATA-CEPHALOCHORDATA	0	0	0	0
CHORDATA-GNATHOSTOMATA	0	23	23	23
TOTAL	160	49	47	207

BCI = Box core infauna: OTS = Otter trawl, soft bottom

Table 7-48. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 31.

Parameter	Cruise*				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	-	-	3,193	3,410	3,302	2,210 - 18,233
Diversity Index	-	-	1.59	1.41	1.50	1.13 - 1.97
Equitability	-	-	0.77	0.72	0.74	0.54 - 0.86

*Station 31 was not sampled on the Year One (Fall and Spring) Cruises.

Table 7-49. Dominant taxa for Station 31, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise*	
	Summer	Winter
Synelmis albini (P)	1	2
Prionospio sp. (P)	2	3
Prionospio cirrobranchiata (P)	3	4
Euchone incolor (P)	3	(+)
Aplacophora sp. B (S)	4	5
Myriochele oculata (P)	5	(-)
Haploscoloplos sp. (P)	(-)	1

(P) = Polychaeta
(S) = Solenogaster-Mollusca
(+) present but not among the five most abundant
(-) = absent

*Station 31 was not sampled on the Year One (Fall and Spring) Cruises.

cating little seasonal variation. However, the orbiniid polychaete Haploscoloplos sp. was abundant only in the Winter Cruise samples.

Macroepifauna -- The fauna from Station 31 was typically that collected from areas of predominantly sand to shelly-sand bottoms. The starfish Astropecten sp. was by far the most abundant species collected. The penaeid shrimps Sicyonia stimpsoni, Solenocera atlantidis, Mesopenaeus tropicalis, and Parapenaeus longirostris as well as the processid shrimps Processa tenuipes and Pantomus parvulus were also abundant. These shrimps frequent the sand/shell habitats. The other less abundant invertebrate species all have an affinity to sandy bottoms.

The dominant fish species, too, were those typical of sandy bottoms and included: lizardfishes, Synodus synodus and Saurida normani; cusk eels, Lepophidium spp.; and flounders, Citharichthys cornutus and Syacium papillosum.

7.3.17 Station 33

Physical Features -- Station 33 was located at 26°16.53'N, 84°05.97'W; 188 km from shore. Across the station block, there was a general downward slope from east to west. Depths ranged from 146 to 149m. Soft bottom substrates, composed of fine sand sediments, predominated. A few small rock outcrops were also observed at this site.

Taxonomic Richness & Composition -- Benthic biological collections yielded 207 taxa (identified to genus or species) at Station 33 (Table 7-50). Most of these (71%) were infaunal organisms. Three major groups contributed 86% of all taxa identified at this station. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (43%), Crustacea (31%), and Gnathostomata (fishes) (12%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-51 summarizes faunal density estimates and diversity and equitability values from box core data from Station 33. Faunal density was among the lowest observed at any station and was slightly higher during winter than summer. Likewise, diversity values were

Table 7-50. Soft bottom Station 33, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	0	0	0
CNIDARIA	0	0	0	0
ANNELIDA	89	0	0	89
GASTROPODA	4	0	0	4
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	2	0	0	2
BIVALVIA	8	1	1	9
SCAPHOPODA	1	0	0	1
CEPHALOPODA	0	2	2	2
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	42	23	23	65
SIPUNCULA	0	0	0	0
PRIAPULIDA	0	0	0	0
PHORONIDA	0	0	0	0
ECTOPROCTA	1	0	0	1
BRACHIOPODA	0	0	0	0
ECHINODERMATA	0	8	8	8
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	1	1	1
CHORDATA-CEPHALOCHORDATA	0	0	0	0
CHORDATA-GNATHOSTOMATA	0	25	25	25
TOTAL	147	60	60	207

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-51. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 33.

Parameter	Cruise*				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	-	-	2,943	3,363	3,153	2,210 - 18,233
Diversity Index	-	-	1.68	1.27	1.48	1.13 - 1.97
Equitability	-	-	0.82	0.68	0.75	0.54 - 0.86

*Station 33 was not sampled on the Year One (Fall and Spring) Cruises.

generally low, but the Winter Cruise value was much lower than for the Summer Cruise. Equitability values were moderately high but were lower during winter than summer.

Dominant Infaunal Taxa -- Table 7-52 lists the most abundant taxa from the box core samples from Station 33 for each cruise; all were polychaetes. Only the pilargid *Synelmis albini* was among the most abundant for both cruises, and most of the dominants for the Winter Cruise (including the most abundant species, the orbiniid polychaete *Haploscoloplos* sp.) were not present in Summer Cruise samples. These differences and the seasonal changes in diversity and equitability suggest significant variation in composition of the infaunal assemblage.

Macroepifauna -- The fauna collected at this station was a mixture of species typical of either shelly sand or rock outcroppings. The most abundant group of invertebrates during the Winter Cruise were the echinoderms (30% of total number of species), and the starfish *Astropecten* sp., which is more commonly found on sandy habitats, was the most abundant echinoderm species. *Neocomatella pulchella*, a crinoid, was the other abundant echinoderm present. This species is commonly found lodged in crevices of rock outcroppings and was typically abundant at several outer shelf live bottom stations. Other species of invertebrates collected from both cruises are commonly found inhabiting rock outcroppings or live bottom areas. These species included: the echinoid *Stylocidaris affinis*; and crabs, *Stenocionops spinosissima*, *Euprognatha rastellifera*, and *Acanthocarpus alexandri*. The galatheid crab, *Munida* sp., which commonly occurs on sandy/shell bottoms, was the most abundant invertebrate species collected from either cruise.

The fish species collected showed a preference toward sandy substrata, but other species inhabited sheltered areas of rock outcroppings. The species which prefer sand bottoms included: lizardfishes, *Synodus synodus* and *Saurida* spp.; flounders, *Citharichthys cornutus* and *Syacium papillosum*; and sea robins, *Bellator* spp. Those which prefer rock outcroppings included: sea basses, *Centropristis* sp. and *Serranus phoebe*; and scorpionfishes, *Scorpaena* spp.

Table 7-52. Dominant taxa for Station 33, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise*	
	Summer	Winter
Synelmis albini (P)	1	2
Prionospio cirrifera (P)	2	(+)
Levinsenia acutibranchiata (P)	3	(-)
Prionospio cirrobranchiata (P)	4	(+)
Sphaerosyllis sp. (P)	5	(+)
Tharyx marioni (P)	5	(+)
Haploscoloplos sp. (P)	(-)	1
Levinsenia gracilis (P)	(-)	3
Prionospio sp. (P)	(-)	4
Polychaeta sp. E (P)	(-)	5

(P) = Polychaeta (+) present but not among the five most abundant
(-) = absent

*Station 33 was not sampled on the Year One (Fall and Spring) Cruises.

7.3.18 Station 34

Physical Features -- Station 34 was located at 25°45.31'N, 83°57.63'W; 208 km from shore. Depths ranged from 133 to 135m, with the greatest depths recorded at the center of the station block. From the station center, a gradual upward slope was evident to both the northwest and southeast. Bottom substrates were composed of medium sand sediments.

Taxonomic Richness & Composition -- Benthic biological collections yielded 235 taxa (identified to genus or species) at Station 34 (Table 7-53). Approximately 73% of these were infaunal organisms. Six major groups contributed 97% of all taxa. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (46%), Crustacea (28%), Gnathostomata (fishes) (8%), Bivalvia (6%), Echinodermata (5%), and Gastropoda (4%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-54 summarizes faunal density estimates and diversity and equitability values for box core data from Station 33. As at several of the other deep stations, faunal density was low; the estimate for winter was slightly higher than for summer. Diversity values were moderately low and the winter estimate was lower than that for summer. Equitability values were high and consistent between seasonal samples.

Dominant Infaunal Taxa -- Table 7-55 lists the most abundant taxa from the box core samples from Station 34 for each cruise. Seven of the eight taxa listed are polychaetes. The polychaetes *Synelmis albini* (pilargid) and *Tharyx annulosus* (cirratulid) were the only taxa ranking among the most abundant on both cruises. Three of the dominants on the Winter Cruise (including the orbiniid *Haploscoloplos* sp.) and two of those on the Summer Cruise were absent from the other seasonal samplings. These results indicate significant seasonal variation in the composition of the infaunal assemblage at Station 34.

Macroepifauna -- The invertebrate species collected were a mixture of sand-inhabiting and reef species, although the strictly reef/live bottom invertebrates (sponges and ascidians) were not collected. A majority of the species collected from the Summer Cruise were echinoderms, including both sand

Table 7-53. Soft bottom Station 34, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	1	1	1
CNIDARIA	0	0	0	0
ANNELIDA	107	0	0	107
GASTROPODA	4	6	6	10
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	3	0	0	3
BIVALVIA	13	1	1	14
SCAPHOPODA	1	0	0	1
CEPHALOPODA	0	2	2	2
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	42	26	25	67
SIPUNCULA	0	0	0	0
PRIAPULIDA	0	0	0	0
PHORONIDA	0	0	0	0
ECTOPROCTA	0	0	0	0
BRACHIOPODA	0	0	0	0
ECHINODERMATA	1	11	11	12
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	0	0	0
CHORDATA-CEPHALOCHORDATA	0	0	0	0
CHORDATA-GNATHOSTOMATA	0	18	18	18
TOTAL	171	65	64	235

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-54. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 34.

Parameter	Cruise*				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	-	-	3,447	4,633	4,040	2,210 - 18,233
Diversity Index	-	-	1.68	1.42	1.55	1.13 - 1.97
Equitability	-	-	0.79	0.75	0.77	0.54 - 0.86

*Station 34 was not sampled on the Year One (Fall and Spring) Cruises.

Table 7-55. Dominant taxa for Station 34, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise*	
	Summer	Winter
Synelmis albini (P)	1	1
Paraonis gracilis (P)	2	(-)
Laevicardium sp. (Bi)	3	(+)
Barantolla cf. lepte (P)	4	(-)
Tharyx annulosus (P)	5	5
Haploscoloplos sp. (P)	(-)	2
Levinsenia gracilis (P)	(-)	3
Polychaeta sp. E (P)	(-)	4

(P) = Polychaeta (+) present but not among the five most abundant
(Bi) = Bivalvia (-) = absent

*Station 34 was not sampled on the Year One (Fall and Spring) Cruises.

and live bottom types. Abundant species that are associated with sandy habitats included: galatheid crabs, *Munida* spp.--the most abundant species on both cruises; shrimps, *Mesopenaeus tropicalis* and *Processa tenuipes*; and crab, *Calappa sulcata*. Those species typical of reef areas or live bottom included: crabs, *Stenocionops spinimana* and *Stenorhynchus* spp.; and echinoderms, *Stylocidaris affinis* and *Comactinia meridionalis*.

The fish fauna also included a mixture of species that prefer sand bottom (flounders, *Citharichthys* spp.; sea robins, *Bellator egretta* and *Prionotus roseus*; and lizardfishes, *Synodus intermedius* and *Saurida* sp.) and live bottom (scorpionfishes, *Scorpaena* spp.; and sea bass, *Serranus phoebe*) areas.

7.3.19 Station 37

Physical Features — Station 37 was located at 25°16.64'N, 84°09.39'W; 258 km from shore. Depths ranged from 147 to 149m and a general downward slope from east to west across the station block was indicated. Bottom substrates consisted of poorly sorted, medium sand sediments.

Taxonomic Richness & Composition — Benthic biological collections yielded 253 taxa (identified to genus or species) at Station 37 (Table 7-56). Most of these (84%) were infaunal. Five major groups accounted for 93% of all taxa identified at this site. Listed in order of decreasing numbers of taxa, these groups were Annelida (polychaetes) (50%), Crustacea (25%), Bivalvia (7%), Gastropoda (6%), and Gnathostomata (fishes) (6%).

Infaunal Abundance, Diversity, & Equitability -- Table 7-57 summarizes faunal density estimates and diversity and equitability values for box core data from Station 37. Faunal density was three times higher on the Winter Cruise than the Summer Cruise; thus, although the Summer Cruise value was not particularly high, the average of the two estimates was the highest overall among stations. The elevated Winter Cruise value primarily reflects the high abundance of the orbiniid polychaete *Haploscoloplos* sp. Both diversity and equitability were very low and seasonally consistent.

Table 7-56. Soft bottom Station 37, all cruises combined: Number of taxa identified to genus or species level from box core (BCI) and otter trawl (OTS) samples. Breakdown by major groups.

TAXONOMIC GROUP	# TAXA (BCI)	# TAXA (OTS)	# ADDITIONAL TAXA	CUMULATIVE # TAXA
CYANOPHYTA	0	0	0	0
CHLOROPHYCOPHYTA	0	0	0	0
PHAEOPHYCOPHYTA	0	0	0	0
RHODOPHYCOPHYTA	0	0	0	0
ANTHOPHYTA	0	0	0	0
PROTOZOA	0	0	0	0
PORIFERA	0	1	1	1
CNIDARIA	0	0	0	0
ANNELIDA	127	0	0	127
GASTROPODA	10	4	4	14
POLYPLACOPHORA	0	0	0	0
APLACOPHORA	3	0	0	3
BIVALVIA	16	1	1	17
SCAPHOPODA	2	0	0	2
CEPHALOPODA	0	5	5	5
ARTHROPODA-PYCNOGONIDA	0	0	0	0
ARTHROPODA-MANDIBULATA-CRUSTACEA	52	12	11	63
SIPUNCULA	0	0	0	0
PRIAPULIDA	0	0	0	0
PHORONIDA	0	0	0	0
ECTOPROCTA	0	0	0	0
BRACHIOPODA	2	0	0	2
ECHINODERMATA	0	5	5	5
HEMICHORDATA	0	0	0	0
CHORDATA-UROCHORDATA	0	0	0	0
CHORDATA-CEPHALOCHORDATA	0	0	0	0
CHORDATA-GNATHOSTOMATA	0	14	14	14
TOTAL	212	42	41	253

ABBREVIATIONS: BCI = BOX CORE SAMPLES; OTS = OTTER TRAWL.

BCI = Box core infauna; OTS = Otter trawl, soft bottom

Table 7-57. Faunal density estimates (number of organisms m^{-2}), diversity values (Shannon-Weaver Index), and equitability values (Pielou's J') for soft bottom Station 37.

Parameter	Cruise*				Mean	Range of Values over All Stations/Cruises
	Fall	Spring	Summer	Winter		
Faunal Density	-	-	5,053	18,233	11,643	2,210 - 18,233
Diversity Index	-	-	1.30	1.24	1.27	1.13 - 1.97
Equitability	-	-	0.61	0.59	0.60	0.54 - 0.86

*Station 37 was not sampled on the Year One (Fall and Spring) Cruises.

Dominant Infaunal Taxa -- Table 7-58 lists the most abundant taxa from the box core samples from Station 37 for both cruises. Eight of the nine taxa are polychaetes. Only the polychaete *Synelmis albini* and the bivalve *Laevicardium* sp. ranked among the most abundant taxa for both cruises. Two dominant taxa from the Summer Cruise and two from the Winter Cruise were absent on the other cruise. Therefore, significant seasonal variation in the particularly abundant taxa was apparent, although not reflected in the overall community structure indices.

Macroepifauna -- Most invertebrates collected during the Summer Cruise were those associated with live bottom, those being the molluscs, *Vermicularia fargoi* and *Octopus* spp., and the echinoderms, *Stylocidaris affinis* and *Coelopleurus floridanus*. Only two fish species were collected during this cruise (moray eel, *Gymnothorax* spp.; sea robin, *Prionotus* sp.). A majority of invertebrate species collected during the Winter Cruise are also associated with live bottom habitats, including the crab *Stenocionops spinosissima* and the echinoderm *Stylocidaris affinis*--the most abundant species collected. The galatheid crab, *Munida* sp., which prefers sand bottoms, was the second most abundant species collected.

A majority of the 12 fish species collected on the Winter Cruise normally inhabit sandy areas (lizardfishes, *Synodus synodus* and *Saurida brasiliensis*; sea robins, *Prionotus stearnsi* and *Bellator* spp.; and flounder, *Citharichthys cornutus*). Only two species, the sea bass *Serranus phoebe* and the scorpionfish *Scorpaena agassizi*, are common in reef or live bottom areas.

7.4 SHELFWIDE PATTERNS

This section describes shelfwide patterns in soft bottom assemblages on the basis of box core and otter trawl sampling.

7.4.1 Infauna: Box Core Data

A total of 1,378 taxa were collected in box core sampling, of which 1,227 (89%) were identified to genus or species. Over 50% of these taxa were polychaetes,

Table 7-58. Dominant taxa for Station 37, for each cruise, based on the five most abundant organisms identified to the genus or species level from box core samples. Values are ranks.

Taxon (Group)	Cruise*	
	Summer	Winter
Laevicardium sp. (Bi)	1	4
Synelmis albini (P)	2	2
Haplosyllis spongicola (P)	3	(+)
Lumbrineris latreilli (P)	4	(-)
Barantolla cf. lepte (P)	5	(-)
Euchone incolor (P)	5	(+)
Haploscoloplos sp. (P)	(-)	1
Polychaeta sp. E (P)	(-)	3
Nereimyra sp. A (P)	(+)	5

(P) = Polychaeta (+) present but not among the five most abundant
(Bi) = Bivalvia (-) = absent

*Station 37 was not sampled on the Year Two (Fall and Spring) Cruises.

with crustaceans, bivalves, and gastropods also contributing significant proportions of the total. Widely distributed taxa included the polychaetes Synelmis albini (Pilargidae), Notomastus hemipodus (Capitellidae), Levinsenia gracilis (Paraonidae), Tharyx annulosus (Cirratulidae), Prionospio steenstrupi (Spionidae), Sthenelais boa (Sigalionidae), and Fabricia sp. (Sabellidae), as well as the cephalocarid crustacean Sarsiella sp.

7.4.1.1 Taxonomic Richness, Abundance, Diversity, & Equitability

Figure 7-2 illustrates shelfwide variation in total taxa (identified to genus or species) collected in the box cores. Among stations that were sampled on all four cruises (which consequently had a higher number of taxa collected), taxonomic richness appeared highest at several mid shelf stations (4, 16, 22, and 28). The number of taxa collected at the deep (>100m) offshore stations was generally low in comparison, even considering that they were sampled on only two of the four cruises. Taxonomic richness was also low at Stations 25 and 26, which are located in the southeast corner of the study area.

Shelfwide patterns of faunal abundance for all stations and cruises are summarized in Table 7-59. The highest average densities occurred at the deep Station 37 (although the average belies the large difference between results of the two sampling dates); densities were also high at Stations 6, 14, 20, and 22, all at relatively shallow depths. Two of the stations that supported the highest average faunal densities (Stations 6 and 37) also exhibited the highest degree of "seasonal" variation in faunal density. In contrast to the results for Station 37, most of the other relatively deep stations (5, 12, 31, 33, 34) supported low faunal densities. Remaining stations supported intermediate densities. These observations are summarized in Figure 7-3.

Diversity values (Shannon-Weaver Index) for all stations and cruises are summarized in Table 7-60. Values were consistently lowest at Station 37 (despite the large between-cruise difference in faunal density there); other stations ranking low on the average were Stations 6, 25, 26, and 33. The highest diversity values were noted at mid shelf Stations 4, 16, 22, and 28, as well as Station 20. These observations are summarized in Figure 7-4.

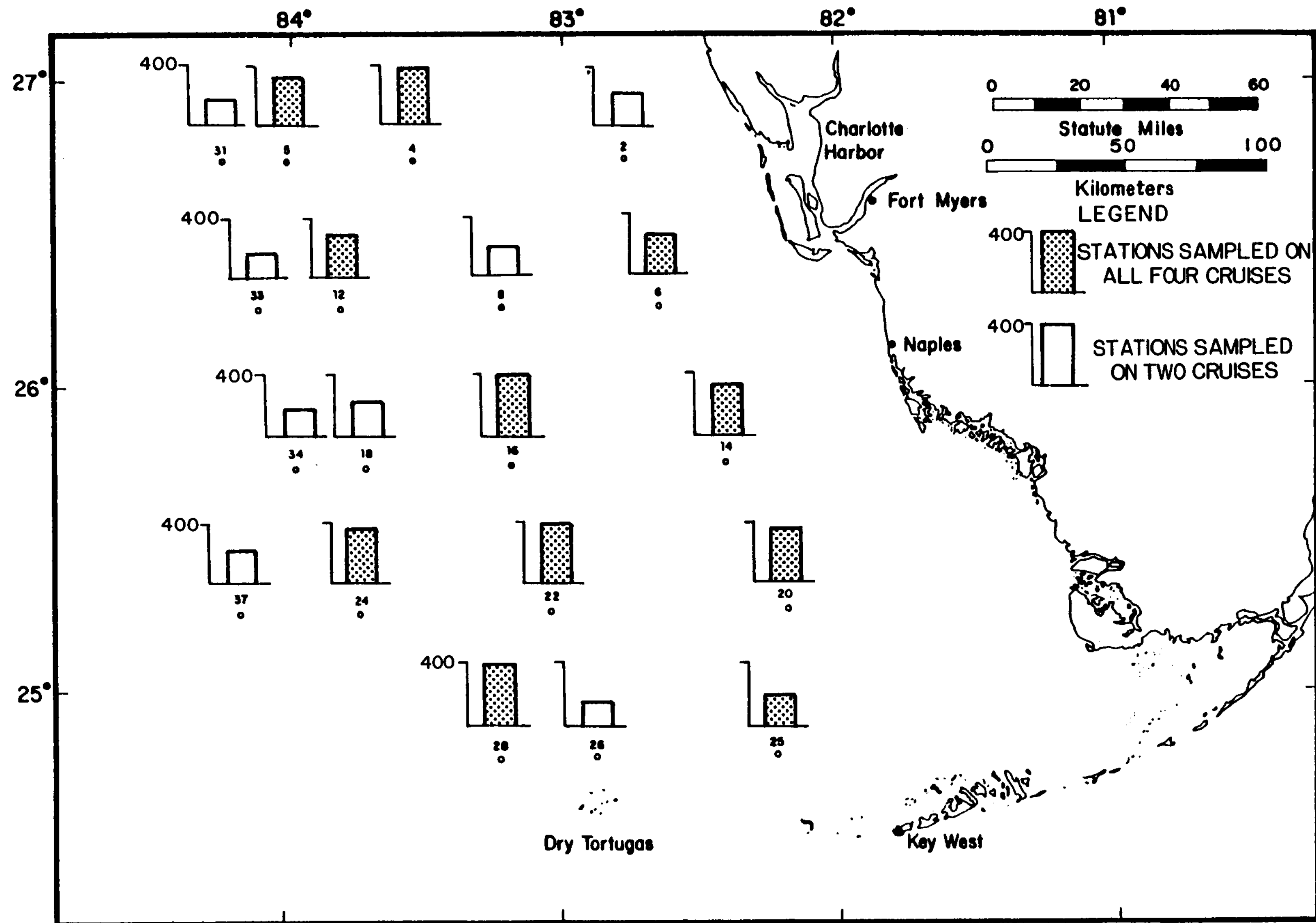


Figure 7-2. Shelfwide variation in the total of taxa (identified to genus or species) collected in box core samples at soft bottom stations,

Table 7-59. Faunal densities (number of organisms m^{-2}) for soft bottom benthic stations, based on box core samples.

Station	Transect	Depth (m)	Cruise: Fall	Spring	Summer	Winter	Mean	Station Rank
2	A	25	6696	9200	-	-	7948	7
4	A	55	2767	5003	3620	6096	4372	14
5	A	90	2227	3710	2680	3313	2983	19
6	B	26	9393	3940	14269	10187	9447	3
8	B	48	5040	5570	-	-	5305	12
12	B	90	3343	3833	2210	3737	3281	17
14	C	26	9436	8586	14156	13419	11399	2
16	C	54	4890	7756	6503	7453	6650	10
18	C	86	3817	4930	-	-	4373	13
20	D	23	6516	8246	8343	10566	8418	4
22	D	52	6770	9083	10652	6063	8142	5
24	D	88	3780	4170	7970	9083	6251	11
25	E	24	6203	9776	7496	4223	6925	9
26	E	38	5270	9553	-	-	7411	8
28	E	59	6676	6923	10283	8280	8040	6
31	A	142	-	-	3193	3410	3302	16
33	B	146	-	-	2943	3363	3153	18
34	C	136	-	-	3447	4633	4040	15
37	D	148	-	-	5053	18233	11643	1

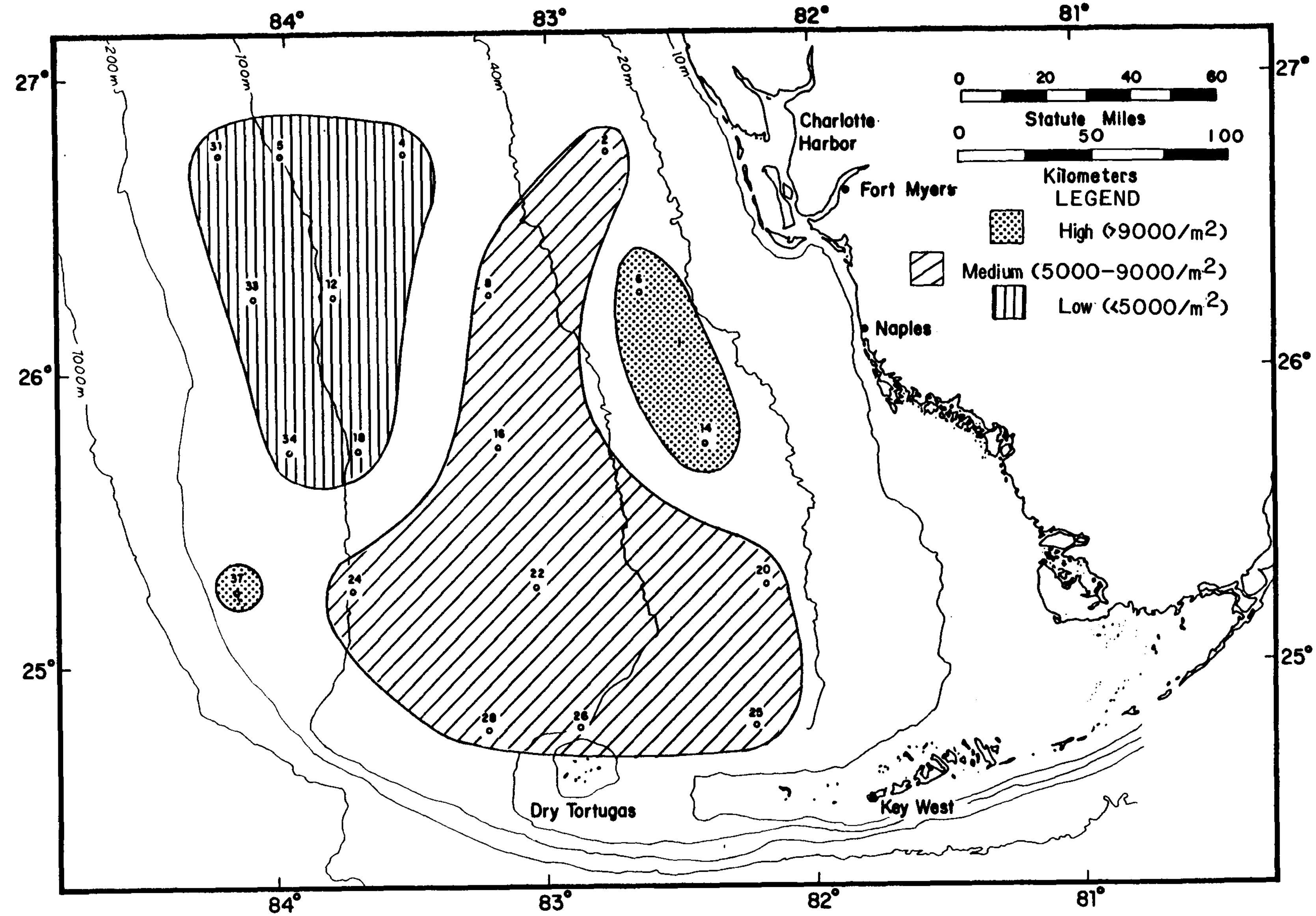


Figure 7-3. Major patterns of average infaunal abundance (no. of organisms/m^2) from box core infaunal data. Abundance categories are arbitrary.

Table 7-60. Species diversity values (Shannon-Weaver H') for soft bottom benthic stations, based on box core samples.

Station	Transect	Depth (m)	Cruise: Fall	Spring	Summer	Winter	Mean	Station Rank
2	A	25	1.79	1.30	-	-	1.54	10
4	A	55	1.77	1.85	1.82	1.68	1.78	3
5	A	90	1.51	1.72	1.58	1.59	1.60	6
6	B	26	1.37	1.33	1.13	1.36	1.30	15
8	B	48	1.57	1.59	-	-	1.58	8
12	B	90	1.65	1.57	1.68	1.56	1.62	5
14	C	26	1.61	1.58	1.62	1.54	1.59	7
16	C	54	1.88	1.75	1.93	1.72	1.82	1
18	C	86	1.54	1.63	-	-	1.58	8
20	D	23	1.71	1.77	1.88	1.78	1.78	3
22	D	52	1.73	1.74	1.81	1.64	1.73	4
24	D	88	1.63	1.66	1.54	1.53	1.59	7
25	E	24	1.31	1.38	1.42	1.28	1.35	14
26	E	38	1.35	1.54	-	-	1.44	13
28	E	59	1.90	1.97	1.67	1.63	1.79	2
31	A	142	-	-	1.59	1.41	1.50	11
33	B	146	-	-	1.68	1.27	1.48	12
34	C	136	-	-	1.68	1.42	1.55	9
37	D	148	-	-	1.30	1.24	1.27	16

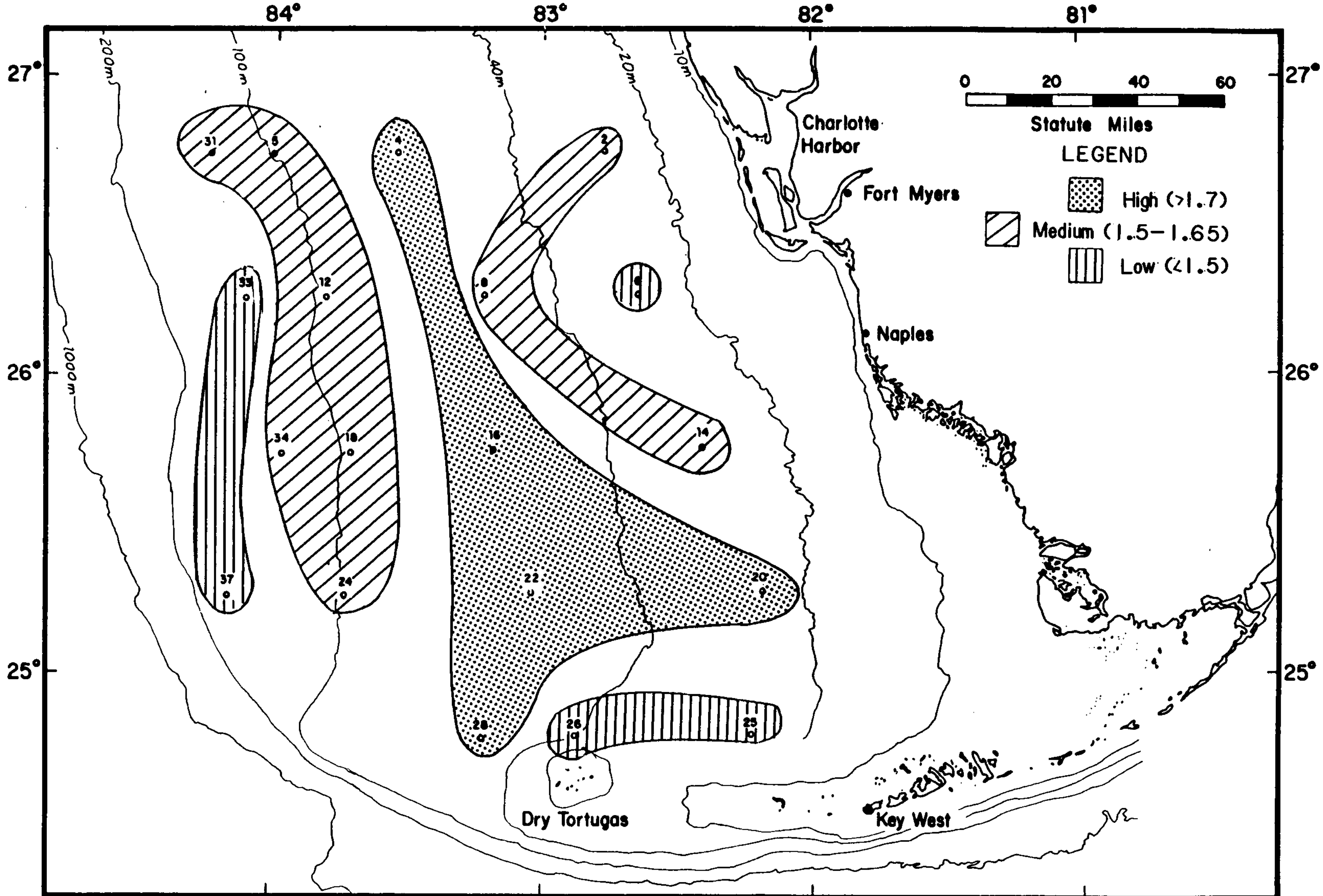


Figure 7-4. Shelfwide patterns of average diversity (Shannon-Weaver Index) based on box core infaunal data. Categories are arbitrary.

Equitability values (Pielou's J') for all stations and cruises are summarized in Table 7-61. The highest values were observed at Stations 20, 4, and 16, and particularly low values were recorded at Stations 6 and 37. Most stations exhibited intermediate values in the 0.70 to 0.80 range with no evident shelfwide trend. Results are illustrated in Figure 7-5. The stations having the lowest equitability values generally had low diversity and high faunal densities. Stations that exhibited high equitability generally also had high diversity values but there was no consistent relationship to overall faunal density. However, the lower diversity values noted in winter vs. summer at several middle and outer shelf stations appear to reflect in part a winter population boom of the orbiniid polychaete *Haploscoloplos* sp.--especially at Stations 4, 28, and 37, and to a lesser extent at Stations 6, 12, 16, 22, 31, and 33.

7.4.1.2 Cluster Analysis

Results of the cluster analysis for the Fall Cruise are illustrated in Figure 7-6. Two major clusters were evident. One consisted of all offshore (4, 5, 12, 18, and 24) and mid shelf (8, 16, 22, and 28) stations with the addition of nearshore Stations 2 and 20, which clustered together. Within the offshore group, the northern Stations 4 and 5 subclustered separately from Stations 12, 18, and 24. The second major cluster consisted of two station pairs: Stations 6 and 14, and Stations 25 and 26. The latter pair of stations was located in the area of fine sediments near the Tortugas pink shrimp grounds.

Results of the cluster analysis for the Spring Cruise are illustrated in Figure 7-7. As for the Fall Cruise, there were two major cluster groupings, although the component stations of subclusters were slightly different. One major group consisted of the offshore Stations 5, 12, 18, and 24; an intermediate subgroup contained Stations 4, 8, 16, 20, 22, and 28. The major nearshore group consisted of Stations 2, 6, 14, 25, and 26; Stations 25 and 26 subclustered separately. The major changes between the results of the Spring Cruise and the previous one were that on the Spring Cruise, Station 4 clustered more closely with mid shelf stations rather than with the offshore group, and Station 2 clustered with the nearshore stations (6 and especially 14) rather than the mid shelf stations.

Table 7-61. Equitability values (Pielou's J') for soft bottom benthic stations, based on box core samples.

Station	Transect	Depth (m)	Cruise: Fall	Spring	Summer	Winter	Mean	Station Rank
2	A	25	0.81	0.67	-	-	0.74	8
4	A	55	0.84	0.82	0.83	0.76	0.81	2
5	A	90	0.75	0.79	0.76	0.76	0.76	6
6	B	26	0.68	0.70	0.54	0.68	0.65	10
8	B	48	0.77	0.78	-	-	0.78	4
12	B	90	0.80	0.75	0.81	0.76	0.78	4
14	C	26	0.78	0.75	0.72	0.69	0.74	8
16	C	54	0.84	0.78	0.84	0.78	0.81	2
18	C	86	0.74	0.74	-	-	0.74	8
20	D	23	0.83	0.82	0.83	0.80	0.82	1
22	D	52	0.78	0.77	0.80	0.77	0.78	4
24	D	88	0.78	0.76	0.69	0.74	0.74	8
25	E	24	0.72	0.71	0.69	0.74	0.72	9
26	E	38	0.73	0.76	-	-	0.74	8
28	E	59	0.84	0.86	0.71	0.76	0.79	3
31	A	142	-	-	0.77	0.72	0.74	8
33	B	146	-	-	0.82	0.68	0.75	7
34	C	136	-	-	0.79	0.75	0.77	5
37	D	148	-	-	0.61	0.59	0.60	11

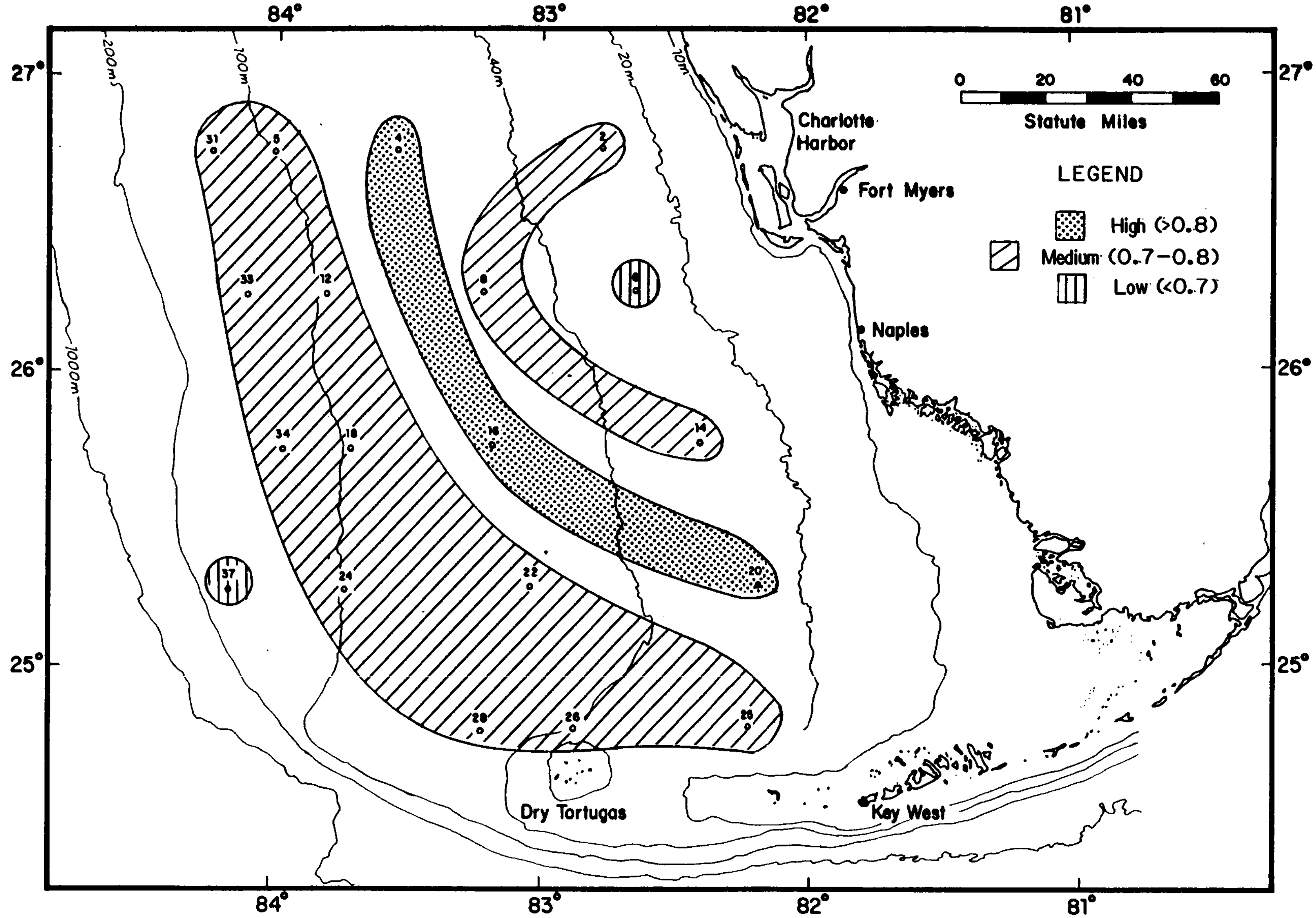


Figure 7-5. Shelfwide patterns in average equitability (Pielou's J') based on box core infaunal data. Categories are arbitrary.

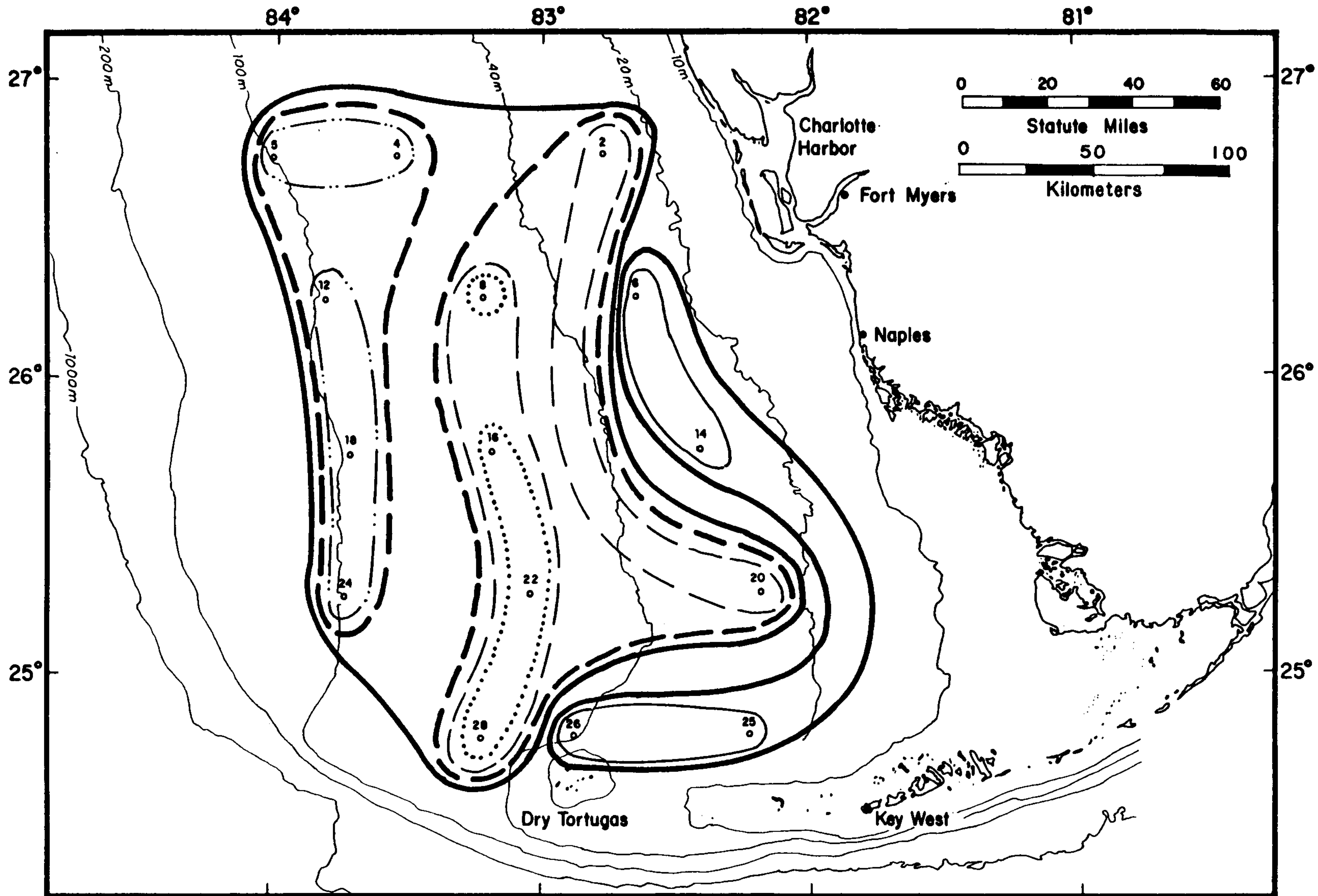


Figure 7-6. Station groupings based on cluster analysis of box core infaunal data, Fall Cruise.

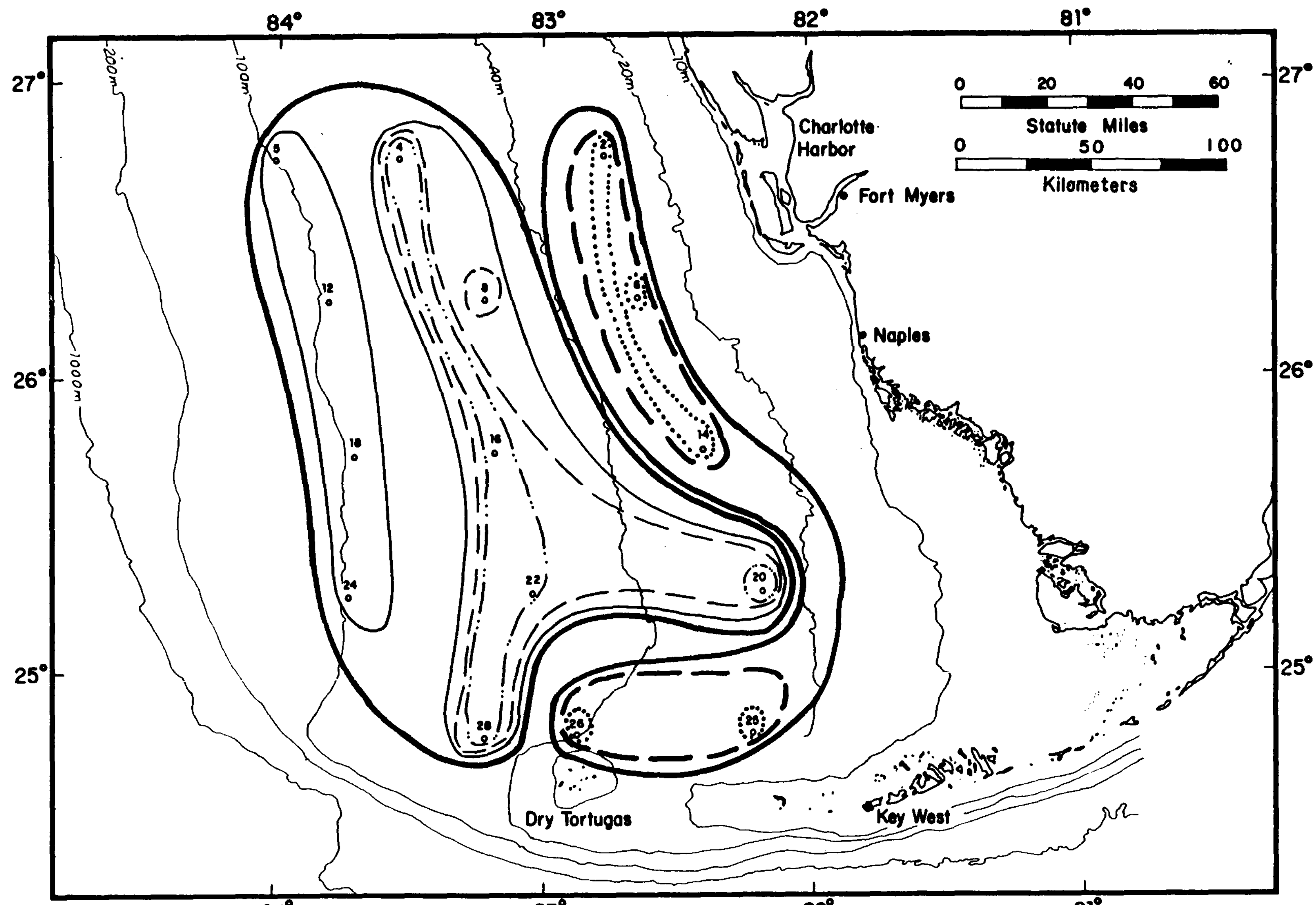


Figure 7-7. Station groupings based on cluster analysis of box core infaunal data, Spring Cruise.

During Year Two sampling, Stations 2, 8, 18, and 26 were deleted and Stations 31, 33, 34, and 37 were added. Although this affected some of the individual station clusters, the overall pattern was not altered.

Results of the cluster analysis for the Summer Cruise are illustrated in Figure 7-8. As for the Year One cruises, two major clusters were recognized, one consisting of the remaining offshore stations from Year One (Stations 5, 12, and 24) with the addition of the new deeper offshore Stations 31, 33, 34, and 37, and the other consisting of all of the other stations. Within the major offshore group, Stations 31, 33, and 34; 5 and 12; and 24 and 37 formed separate subclusters. Within the other major group, subclustering into nearshore (Stations 6, 14, and 25) and mid shelf (Stations 4, 16, 22, and 28, plus the shallower Station 20) groups was evident, with these stations groups resembling those noted for the Spring Cruise data. Within the nearshore group, Station 25 again clustered apart from Stations 6 and 14. Within the mid shelf group, Stations 4 and 20 were more similar to each other than to Stations 16, 22, and 28.

Results of the cluster analysis for the Winter Cruise are illustrated in Figure 7-9. The two major cluster groups were again recognizable and were composed of several subclusters, although the components of each were slightly different from those of the Summer Cruise. The offshore group (Stations 5, 12, 24, 31, 33, 34, and 37) consisted of three subclusters: the first comprising Stations 34 and 37; the second, Stations 5, 12, and 24; and the third, Stations 31 and 33. Within the other major group, there was an intermediate zone consisting of Stations 4, 16, 20, 22, and 28 (with Station 20 clustering out separately from the rest) and a nearshore zone that was exactly the same as for the Summer Cruise.

Results of the cluster analysis for all stations and cruises are presented in Figures 7-10 and 7-11, and two-way tables of species occurrence are presented in Table 7-62. The analysis included 135 taxa, of which 90 (67%) were polychaetes, 30 (22%) were crustaceans, and 8 (6%) were bivalves. The analysis identified two major groups (offshore and nearshore), with subclustering of intermediate vs. nearshore stations within the latter group. Subclusters with-

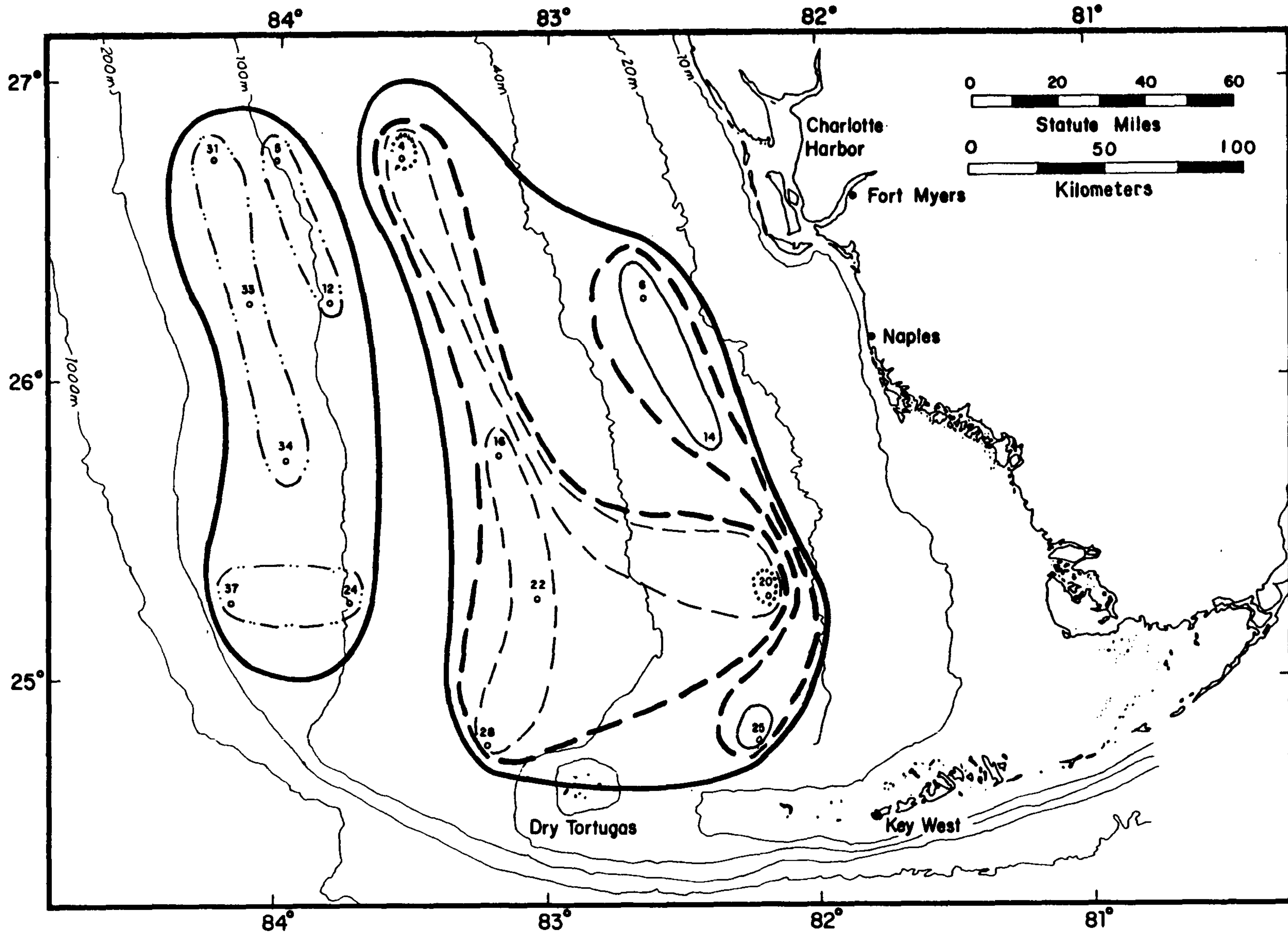


Figure 7-8. Station groupings based on cluster analysis of box core infaunal data, Summer Cruise.

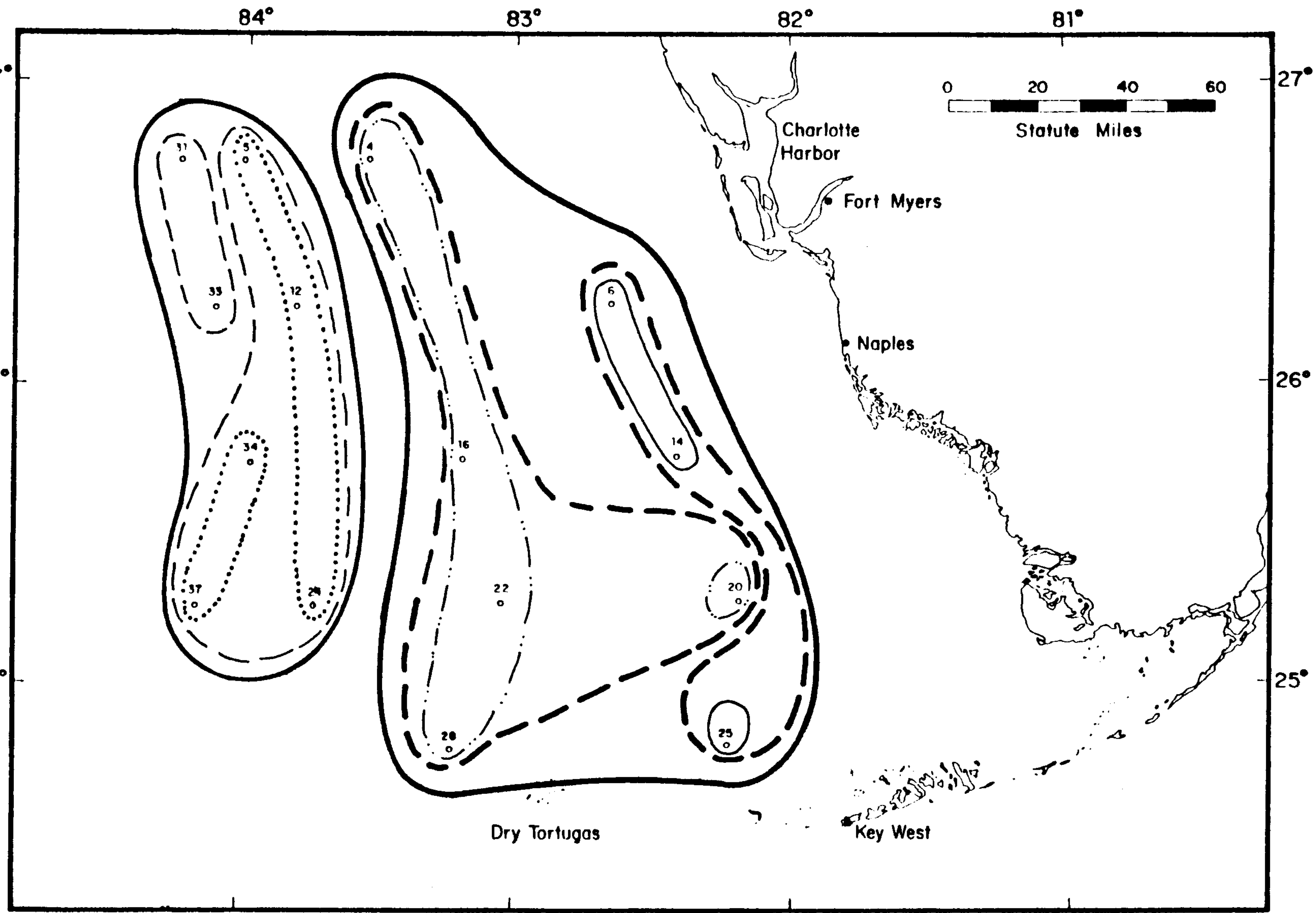


Figure 7-9. Staion groupings based on cluster analysis of box core infaunal data, Winter Cruise, 1982.

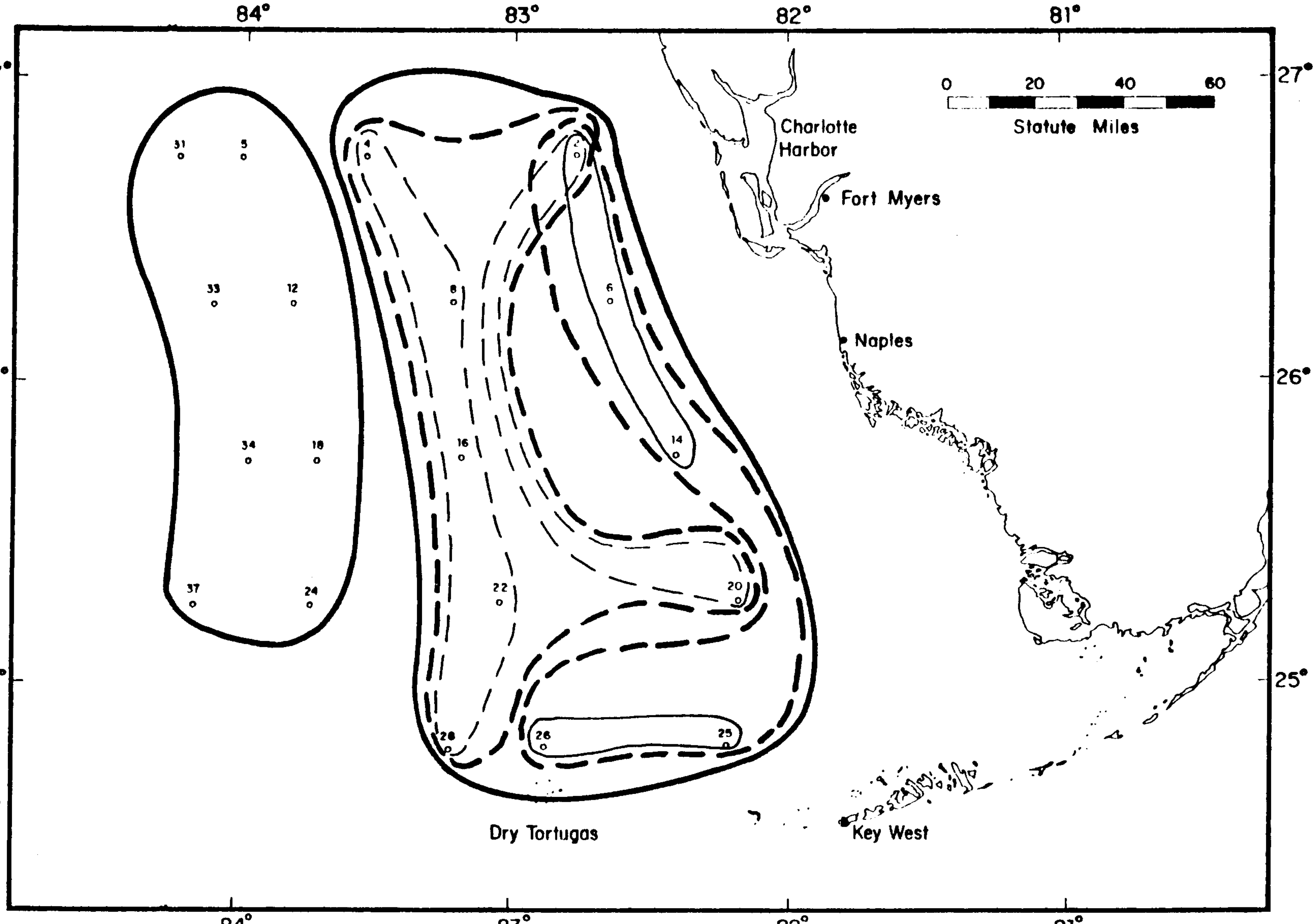
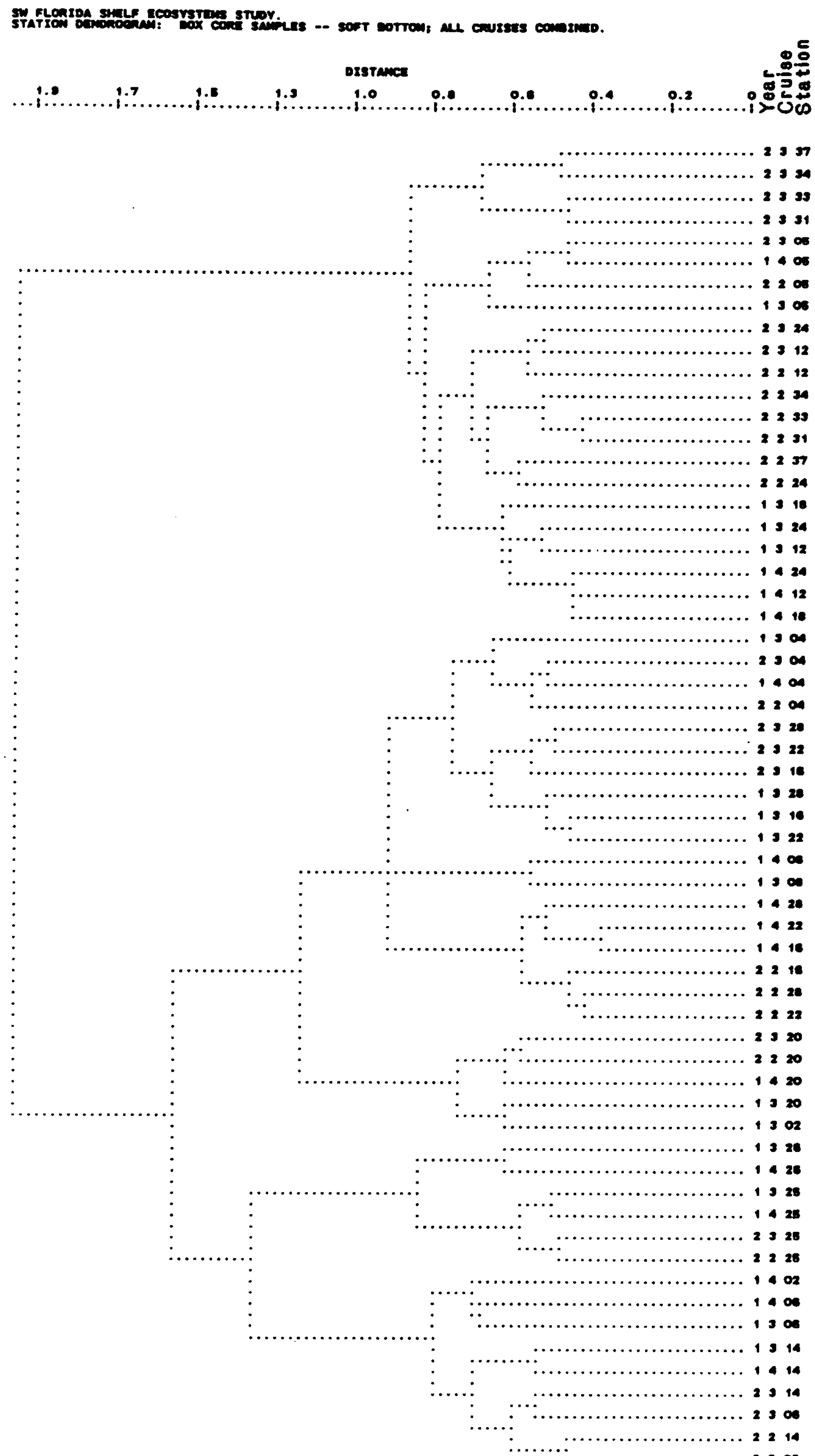


Figure 7-10. Station groupings based on cluster analysis of box core infaunal data, all cruises combined.



NOTE: YEAR 1, CRUISE 3 = FALL CRUISE (OCTOBER 25-NOVEMBER 23, 1980); YEAR 1, CRUISE 4 = SPRING CRUISE (APRIL 22-MAY 5, 1981); YEAR 2, CRUISE 2 = SUMMER CRUISE (JULY 16-AUGUST 5, 1981); YEAR 2, CRUISE 3 = WINTER CRUISE (JANUARY 28-FEBRUARY 15, 1982).

Figure 7-11. Station dendrogram from cluster analysis of box core infaunal data, all cruises combined.

Table 7-62. Two-way table of station/season occurrences of taxa from cluster analysis of box core infaunal data, all cruises combined.

```
YEAR                         2 2 1 1 2 2 2 2 1 1 1 2 2 2 1 1 1 1 2 2 2 1 1 1 2 1 1 1 2 2
CRUISE                       3 3 4 3 3 2 2 2 3 4 4 3 2 3 3 3 3 4 2 2 2 3 3 3 3 4 3 4 3 2
STATION                      3 3 0 0 1 3 3 2 2 2 1 0 0 2 2 2 0 2 1 2 2 2 2 2 2 0 0 1 0 0
                             4 1 5 5 2 4 1 4 4 4 8 4 4 2 8 2 8 2 6 2 0 0 6 5 5 2 6 4 6 6
YEAR                        2 2 2 2 2 2 2 2 1 1 1 1 1 2 2 1 1 1 1 2 2 1 1 1 1 2 1 1 2 2
CRUISE                      3 3 3 2 3 2 2 2 3 3 4 3 4 3 3 3 4 4 4 2 3 4 3 4 4 2 4 3 3 2
STATION                     3 3 0 0 2 1 3 3 1 1 1 0 0 2 1 1 0 2 1 2 2 2 0 2 2 2 0 1 1 1
                            7 3 5 5 4 2 3 7 8 2 2 4 4 8 6 6 8 8 6 8 0 0 2 6 5 5 6 4 4 4
                            123456789012345678901234567890123456789012345678901234567890
TAXON

CAECUM PULCHELLUM                            .                       .   *       .
TELLINA SYBARITICA                                              .         - +
MAGELONA CF. CINCTA                         . .       .  .  -. .         --**-+     .
LEMBOS SP. A                                             ..            +          +
ANCISTROSYLLIS HARTMANAE                 .         .                ++++-
MAGELONA PETTIBONEAE          ..               .       .  . +-   . .    .--+*++-.-+++++-
SIGAMBRA TENTACULATA          ..        .       .     .-. .-+-. ...-     **++++   ..-.--
ARICIDEA WASSI              .        -    .       .    +  .+   -        .++++--.  .*.+ .
LUCINA RADIANS                               .. .   .    +.++++-         ++--   ++++
LYONSIA HYALINA FLORIDANA                      -..       .  . ++ .  .     * + -   .+.
OWENIA FUSIFORMIS                   -                    -    --- -- -   ++-* --++ *+ +-
MEDIOMASTUS CALIFORNIENSIS     ...  . -.--....-.-.  ...-.--+.---.-----...+++++++++*++***
PRIONOSPIO CRISTATA              ..     ...      ....-....-.--.++--+---- -+++++*-+.+++**
MEGALOMMA BIOCULATUM              -            -       -     -++++--  -  ---- +  *   ---
PARAPRIONOSPIO PINNATA         - .              .  .. .--.-.- --+---- +...-+*+++.--+--+-
PRIONOSPIO CIRRIFERA          ... ....  +- .- -.- .-..---------++---.+--.++****..---...
LUMBRINERIS VERRILLI        -    .  .- .  .. .-   +-+-.+.+---.-..--.-+.-++*++++   +++-++
TELLINA SP.                                     .. .-.  .+    +- - -    .  *  +    +++
HETEROPHOXUS SP. A                     - .           -     ..-     +      . +-- - *++.**
LUMBRINERIS ERNESTI                 --     .  +.+.       .   +.      .  . - -+- ++*-*+++
CYCLASPIS SP. A                     .    .            ..   .   -.. ---.-  .    *+-***+-+
SYNCHELIDIUM AMERICANUM          -         .        . .-  ---  -.. --+   -..  -*+--*+++*
ARICIDEA PHILBINAE                    +   .            ..   .+  . +     .   -..+-++++***
ARICIDEA FRAGILIS               ..     ..   .    . --..+..--+*..---*. . -  -.  .*-+*****
LUCINA SP.                    ..  .     .          ...- - - .  . -*+... .    .+ .   *+**
PHOTIS SP. A                                  -- -  -    -    .+- .   -        ..+**
ARICIDEA TAYLORI                   . -       .-. -. -   ++++---+- .+ -++   +-+ - -*+**
HARBANSUS PAUCICHELATUS      -     ...       ++       -- +-- .      +  .-  +     -+ *+
GLOTTIDIA PYRAMIDATA        .   -..  -     -* .+   .--.+--++++++ -.++.-.- --+  *++ -*+++
FABRICIA SP.                .  .----.---.- --.------+-.----+++-+-+++--+----..-+***++++**
MYRIOCHELE OCULATA          -.-----..- -++- - -.- -++-. --.+-+++-------++-*-  .+-*+++.*-
ARMANDIA MACULATA           . .- -+ -.-. - +.....- -+.--+-+-+..-++++++++  .   .+.*-+**-+
MICRODEUTOPUS MYERSI                                   .. - - - -+++ .-*.         *  -*+
RUTIDERMA LICINUM                                 - - .. +-- -------  . +      +++++++++
AORIDAE 1                         -.        -       .  ...    *+ - -  + +      + +- +-+-
CUMELLA SP. B                         .   -   .     - .   ++  --++ +    . ..   +. +**+*+
CUMELLA SP. A                   .            .     -..+--+ +  -+++++-.  . +     -++-* ++
ARICIDEA SIMPLEX            ...-+- -++   .  ++++++                    -
APLACOPHORA SP. B           ---+ ....+-+++-++++++- -
SPIOPHANES WIGLEYI          -- --+++ ++ ++++--  +-         -     --
PLATIDIA CLEPSYDRA          -   -+-+. .   -+ +-+--              .
CALLIANASSA MARGINATA       -   ++- --+----+-+++---+-+-       -
SPIOCHAETOPTERUS OCULATUS    +- --++   - -+-+-+++-         - -  ---  -   - *  +   -
SYNELMIS ALBINI             ++-++++++++++++++++++++++++--++++..-++---.......++--. . ....
TEREBELLIDES STROEMI        ++.----+++-++-+*++--+ ---+.   .- - -+-.- .- .  ++ -  *- . +.
PSEUDOPHILOMEDES SP.             +  - - ++-+ + *++ +--               +-     - -    +  -
HAPLOSCOLOPLOS SP.          *-++-   ++        ...  *  *++           +.    .     ..  -+..
CAPITELLA CAPITATA          +--+-   ++-  .   +     +  +--  -    ..  +    - .       +-+
LAEVICARDIUM SP.            ++---   *--+-++        .   -            *   - +         .  .
GLYCERA OXYCEPHALA          ++-++*+ -  --++          *              ---      .        ..
PRIONOSPIO CIRROBRANCHIATA  -+-+++- ++.+++.- + +-* .-.-  .    ....
UNCIOLA SERRATA             --  --  - -+ ++-- +-+     -+ -  - +   +-           -
EUCHONE INCOLOR             +.--+++ -+-+++++- -.+- .+-..-.-   ++++++      +   .       .
APLACOPHORA SP. A           - --++-.-+-+++--+++-++ -- .- ---  +++-++      -   -
CAMPYLASPIS SP. C           +   +- + -+--++- - -          ++  +---++      -
PROTODORVILLEA MINUTA          -     ----+ -  - -+ --  --+      ++++               -
FILOGRANA IMPLEXA                      .. ++                      *-          -        .
DIPLODONTA SP.                      .      *                     --.--        -       .+
LEVINSENIA ACUTIBRANCHIATA  .        .  + -+       - .           ++ .         +     -+++
ARICIDEA SP. B                         ---.        - +           -+. +  -     -       *+
HAPLOSYLLIS SPONGICOLA      -.  ---.-..-..**. -.. +.-. *-     -+..++*.- .-    + .   * .
CIRROPHORUS LYRA            . . - - ---  - -       +  .--+        +-**       -      ++.-
ABRA AEQUALIS               .+--+ - +--++++-       .   .         ---*            .  *+-
CIRROPHORUS AMERICANUS           - -        .---++. .    ------+--    ***..+-  * -.+
BRANCHIOSTOMA CARIBAEUM             -             --+ - +   --++ ----- --*     -----+ -
EUNICE VITTATA               .  -+---      .. . .---.----+- .-.-----* +*              +.
PSEUDOVERMILIOPSIS OCCIDENT --. -+ ..  -  --. --- .+ - --.    +       - .*       -
KALLIAPSEUDES SP. A              ---              + .-    .         -+ *           .  +
GONIADIDES CAROLINAE             .         .   .  +*+  . -++   -+.  -+-.+
EHLERSIA CORNUTA                --.... .    +    --++- .   -   -- . **+++          -
```

Table 7-62 (Continued)

```
PROTODORVILLEA KEFERSTEINI          -- .++--+...  -+--++-+    - +.-.  .-- . ****+          .
CIRROPHORUS BRANCHIATUS              - -+  - + -  --  +--++++-   + -        +***+-
ASYCHIS ELONGATA                       -- -     -  + -----    -  + ---   ---     *---+     -
PARAMPHINOME SP. B                  -          -       -- --+*-+  - +   --- - -     *+-     --
AUTOMATE CF. EVERMANNI                .+  +     -          -- -.++-++ .    --++ - - + ++  +. .-+-
LEVINSENIA GRACILIS                 -++--- -++ +    +--+-+-.- ++-+-+++++-  +  -..-++++ +----.+
NOTOMASTUS HEMIPODUS                ----.-----+-+-.--++---..+-++.+++-+++++++-----++-+++- .+-+ +
SCOLOPLOS RUBRA                     -+          +      -     - - -+---- -++ +++-++ -  --++    --
AGLAOPHAMUS VERRILLI                  .+     .++.--  ------. -.+*++.- -+++++**.      .+++.-+-.+-++
GLYCERA TESSELATA                         -  +          + .--+---+-++ --++- .        .-
NOTOMASTUS LATERICEUS                 -+-  -- + - -+  - -+--+++---+*+ -+-+- -       ++ +       -
SARSIELLA SP.                       --. --- +.-----++--+++ +++++-*+--.*+++++-.-. -+.+ -+- +-*.+.
NOTOMASTUS AMERICANUS                 .-- .+++  --*. .+++++-+++*  -      + ++-.-  ..++    -   --
SCHISTOMERINGOS RUDOLPHI            --  ++-- - +  -    ---- + ++--+++ ++++++++++++ -    -     --
ODONTOSYLLIS ENOPLA                 -    +   --      -- -  --- - - -+ +  -++ - -  +       -
AXIOTHELLA SP. A                    +--.    .-+ .-  .- +   ++  ++- -+ +   +*++  *.      -  .. -.+
POECILOCHAETUS JOHNSONI             --+--++-+ -++* -++ +-++--+-+ +-+ -+-+ ++ + -      --  +  + -
THARYX MARIONI                       --+-- - - +++ -+-+-+--+++++ +++--.++-++ ----   -    . --.-+-
THARYX ANNULOSUS                    ++-+-.- ++++-+-+.+++++--+ ++-+-*++*++++++--..- .- -- ---.++++
PRIONOSPIO STEENSTRUPI              . -------++  + +.--+++++++-++-+- +++++--++    . .-  -  +--++
STHENELAIS BOA                        ---+++ ---++-+-     - +++- ++++--++++++++ +    - -- - ++--*+
LEVINSENIA REDUCTA                             .        ++ +   .    ++++-++     -        .+.-
ARICIDEA SUECICA                    .-.-    -        ..  --   + -++*+-+**    .   -.     +  .  -
ARICIDEA CATHERINAE                  -- . .-       - .---+-. - -*--+*++-+++ +    -    -  - .++
MAGELONA SP. A                                          ..--+-*+++*++++++--.-.             ..+
EXOGONE LOUREI                                   .         ++++--  ++++++- . .
GYPTIS BREVIPALPA                    - -  -. .- .- + +--++-*-+.-.---  +-+-- -+*++-- -+-- ..++++-
EXOGONE DISPAR                           -- .+-     **- --+--+-+.  -+ .-----.++++-++   ..--***-*.

DORVILLEA SOCIABILIS                          +-  - -+  - *  +    -    +  -+  +-- +-   -     +   ---
HARBANSUS SP.                       +. ----  -.-+++-    .--   - .  .   - +---++---   * +  --   ++ ++
PHTISICA MARINA                      - - - -   -  -++- --+   -    +- - +++-+++- -  +      --- -- *+
AMPHICTEIS SCAPHOBRANCHIATA           --  + +  +-          -   -       -  --+- -            - + ---+-
DIPLOCIRRUS SP. A                   -     -  ----     +-+ ---   -  + +  +  --     -         + -  *
SPIOPHANES BERKELEYORUM                          .. +-       .-. .+++++++-+       -    -+   +---+
AMPELISCA CF. MACROCEPHALA          .  -        ---       +-      . .   + ++--++      -      -  *++++
PIONOSYLLIS GESAE                   -        .     .       .- . -+.- +-.-+-+++---***+-      .  .+-.
SELENARIA SP.                             -.-   . .  ..--.-++-+.. .+-+**+++-+-+++*-         .-++.++-
PALEANOTUS SP. A                    .    .-. ...     ---...-.+++++*-+-- +++---+++++         ..   ---+.
LEPTOCHELIA SP. A                                    -         -   ---- --  -++-* ++.       .-+-- ++
NEREIS RIISEI                                   - --+- -   - +-- -- -  ---+-  * -+         -- --  +
AMPELISCA SP. B                          --+        -  --   - -  +      -   -+ -+-   +       -  *-- +
SEROLIS MGRAYI                      .-   - - +--    -.+ -   .- +---++-   -  ---+- .-         -  --* *+
LUMBRINERIS LATREILLI                    --  + +--.*++* -++-. .-+ -++-  --.     ..+--        -  --
SPHAEROSYLLIS SP.                   ---.-++-++-++--+--.+++-+*---+--.. -++++++*--.-*    ..    .- -
LAONICE CIRRATA                     - ++     ++- -+  ----+----+-----    + ---- +                *
ONUPHIS PALLIDULA                   ++  +*+-++- - ---- - -  --+  -      +- +-  -          *
EUCLYMENE SP.                             +  ---  - +   +-+  - - -    + * --  -+-          -
LYSIPPE CF. ANNECTENS                   - + +    .. -.++-   +-.. --**+---+.--+ -
SCOLOPLOS CAPENSIS                  -  -----+--        --  -++----++-+  -++**-        +       -
HARPINIA SP. A                        + +- +-    +    -   +-    -  - +-+  ---*++ -            -+
LUMBRINERIS COCCINEA                --  --     + -      - ++-   -    -+  --*-  ++      -          --
APOPRIONOSPIO DAVI                       --        + +-+ -+  +----    -  - + -              -  +-
AMPHARETIDAE GENUS B                -..-+-++-+-.--.+----+- -+++++    + +****+ .  .  . .         .
AMPELISCA AGASSIZI                    ..--      --. +  --++ -   +-       --.+**                  .
APSEUDES SP. A                      -    +-  + -     *.+ .- + .-+ ++..   +  +**        .     - -  .
CHEVALIA MEXICANA                        -.-       . -       +    .        --- .**-
LEMBOS SP.                               -.         * - - -       . . .    + -++* +            - .--
SPIOPHANES BOMBYX                    --         -- -       - --- +++--- -++++++++*    -     *- --- +
CERATOCEPHALE OCULATA               -.        +..-  +--..+ --+-+.*++++++-+-+-++-.-          -- -.**++
CHONE SP.                                   + -.-- .+   .   +  -+.-.--+---**++.+.               ++
AMAEANA TRILOBATA                         -  - --  -    +  -+       --  -+- -+++ -      -         +
PHOLOE MINUTA                       -     + ..   - -. + ++. +*- -.++-.   ++-++-----
SPIO PETTIBONEAE                     +   -*  --          ---  -+- -  -- +-++-++-+                -+-
BRANIA SP. A                        --  + +.+--     +     ++ -----+-      +++++-.               -+-*
MAERA CF. CAROLINIANA                                    .            +  .-+ +
                                    1234567890123456789012345678901234567890123456789012345678901234567890
```

SYMBOL DEFINITIONS: ( ) = ABSENT ; (.) <= 0.5 ; (-) <= 1.0 ; (+) <= 2.0 ;

(*) > 2.0 X WEIGHTED SPECIES MEAN.

NOTE: YEAR 1, CRUISE 3 = FALL CRUISE (OCTOBER 25-NOVEMBER 23, 1980);
YEAR 1, CRUISE 4 = SPRING CRUISE (APRIL 22-MAY 5, 1981);
YEAR 2, CRUISE 2 = SUMMER CRUISE (JULY 16-AUGUST 5, 1981);
YEAR 2, CRUISE 3 = WINTER CRUISE (JANUARY 28-FEBRUARY 15, 1982).

in the offshore group (Stations 5, 12, 18, 24, 31, 33, 34, and 37) reflected some seasonal (= between-cruise) as well as spatial variation. Only for Station 5 did all seasonal samples cluster closely. Stations 31, 33, 34, and 37 exhibited a high level of similarity to each other and a distinct difference between seasonal samples, and Stations 12, 18, and 24 also exhibited a high level of similarity to each other but the Year Two (Summer, Fall) samples were dissimilar to those from Year One. Within the large nearshore group, Stations 2, 4, 8, 16, 20, 22, and 28 formed an intermediate cluster, within which subclustering by station and/or season was evident. Stations 4, 8, and 20 exhibited little seasonal variability. Stations 16, 22, and 28 consistently grouped together but Summer and Fall Cruise samples were dissimilar to those from the Winter and Spring Cruises. The Fall Cruise data for Station 2 grouped with this intermediate cluster, although the other (Spring Cruise) data grouped with the nearshore stations, which included Stations 2, 6, 14, 25, and 26. Stations 25 and 26 clustered together and exhibited little seasonal dissimilarity; Stations 6 and 14 also clustered together and showed little seasonality of composition.

The cluster analysis results for box core data therefore indicate a strong separation of stations along the offshore-nearshore direction, with the outer stations (5, 12, 18, 24, 31, 33, 34, and 37; depth range 86 to 148m) most strongly separated from the rest. Within the larger group of remaining stations, further subclustering into an intermediate (including Stations 2, 4, 8, 16, 20, 22, and 28; depth range from 23 to 59m) and a nearshore zone (including Stations 2, 6, 14, 25, and 26; depth range from 25 to 38m) is evident. The latter two groupings are not strictly along bathymetric contours; Station 20 (23m depth) consistently grouped with stations in the 50 to 60m depth range, as did Station 2 (25m depth) for one cruise. The grouping of Stations 25 and 26 also clearly does not reflect a bathymetric grouping and is related to sediment composition (see Sections 7.5 and 8.2.2). The overall pattern was consistent over seasons, but pronounced seasonality of community composition was evident at some stations. That a general pattern emerges in the "all cruises" analysis suggests that although seasonal variations occur at particular stations, these are generally consistent among similar stations (those within particular subclusters).

Table 7-63 lists taxa that were particularly characteristic of major cluster groupings from the box core data.

7.4.2 Macroepifauna: Otter Trawl Data

A total of 667 taxa were collected in otter trawls at soft bottom stations, of which 621 (93%) were identified to genus or species. About one-third were fishes, with crustaceans, echinoderms, bivalves, gastropods, and sponges contributing significantly to the total. The dusky flounder *Syacium papillosum* was the most ubiquitously distributed species; other widely distributed species included the fringed filefish *Monacanthus ciliatus*, the pancake batfish *Halieutichthys aculeatus*, and the barbfish *Scorpaena brasiliensis*.

7.4.2.1 Taxonomic Richness & Frequently Collected Taxa

Figure 7-12 illustrates shelfwide variation in the total number of taxa (identified to genus or species) collected in otter trawl samples. Among stations that were sampled on all four cruises, the number of taxa collected was highest at mid shelf stations such as Stations 16, 22, and 28. Taxonomic richness was distinctly lower at inner shelf stations and also at the deep (>100m) offshore stations (even taking into consideration that they were sampled only twice).

7.4.2.2 Overview of Macroepifaunal Substratum Affinities

In Section 7.3, macroepifauna at each station were characterized by their affinities for soft (sand) or live bottom habitats. Because trawl sampling at each station encompassed a much larger area of the station than did box core sampling, a variety of habitats could have been encountered, as reflected in part in the composition of the biota collected. Based on the composition of trawl catches, Stations 5, 8, 16, 22, 26, and 28 could be characterized as encompassing areas of moderate to thick live bottom. Stations 2, 6, 31, and 33 supported macroepifauna typical of sand or shell/sand habitats, whereas Stations 4, 12, 14, 18, 20, 24, 25, 34, and 37 supported macroepifaunal assemblages that suggest the presence of scattered live bottom. Between-cruise variations in these assessments were evident, but these were most pronounced at

Table 7-63. Box core-collected taxa that were characteristic of particular station groupings from "all cruises" cluster analysis. Taxa listed are those whose occurrence was restricted to stations in the respective clusters or that were particularly abundant at those stations.

I. **Offshore** (Stations 5, 12, 18, 24, 31, 33, 34, and 37)--Depth Range 86 to 148m

Aplacophora sp. B (solenogaster)
Callianassa marginata (decapod)
Glycera oxycephala (polychaete)
Prionospio cirribranchiata (polychaete)
Spiophanes wigleyi (polychaete)
Aricidea simplex (polychaete) (primarily at Stations 5, 12, 18, 24)

II. **Mid-Shelf** (Stations 2, 4, 8, 16, 20, 22, and 28)--Depth Range 23 to 59m

Spiophanes bombyx (polychaete)

II.A. Stations 2 and 20--Depth Range 23 to 25m

Ancistrosyllis hartmanae (polychaete)
Ehlersia cornuta (polychaete)
Protodorvillea kefersteini (polychaete)

II.B. Stations 4, 8, 16, 22, and 28--Depth Range 48 to 59m

Exogone lourei (polychaete)
Magelona sp. A (polychaete)

III. **Nearshore** (Stations 2, 6, 14, 25, and 26)--Depth Range 24 to 38m

Aricidea wassi (polychaete)
Lumbrineris verrilli (polychaete)
Magelona pettiboneae (polychaete)
Mediomastus californiensis (polychaete)
Owenia fusiformis (polychaete)
Prionospio cristata (polychaete)

III.A. Stations 2, 6, and 14--Depth Range 25 to 26m

Cyclaspis sp. A (cumacean)
Aricidea philbinae (polychaete)
Rutiderma licinum (ostracod)
Synchelidium americanum (amphipod)

Table 7-63. (Continued).

III.B. Stations 25 and 26--Depth Range 24 to 38m

Magelona cf. cincta (polychaete)
Paraprionospio pinnata (polychaete)
Prionospio cirrifera (polychaete)
Sigambra tentaculata (polychaete)

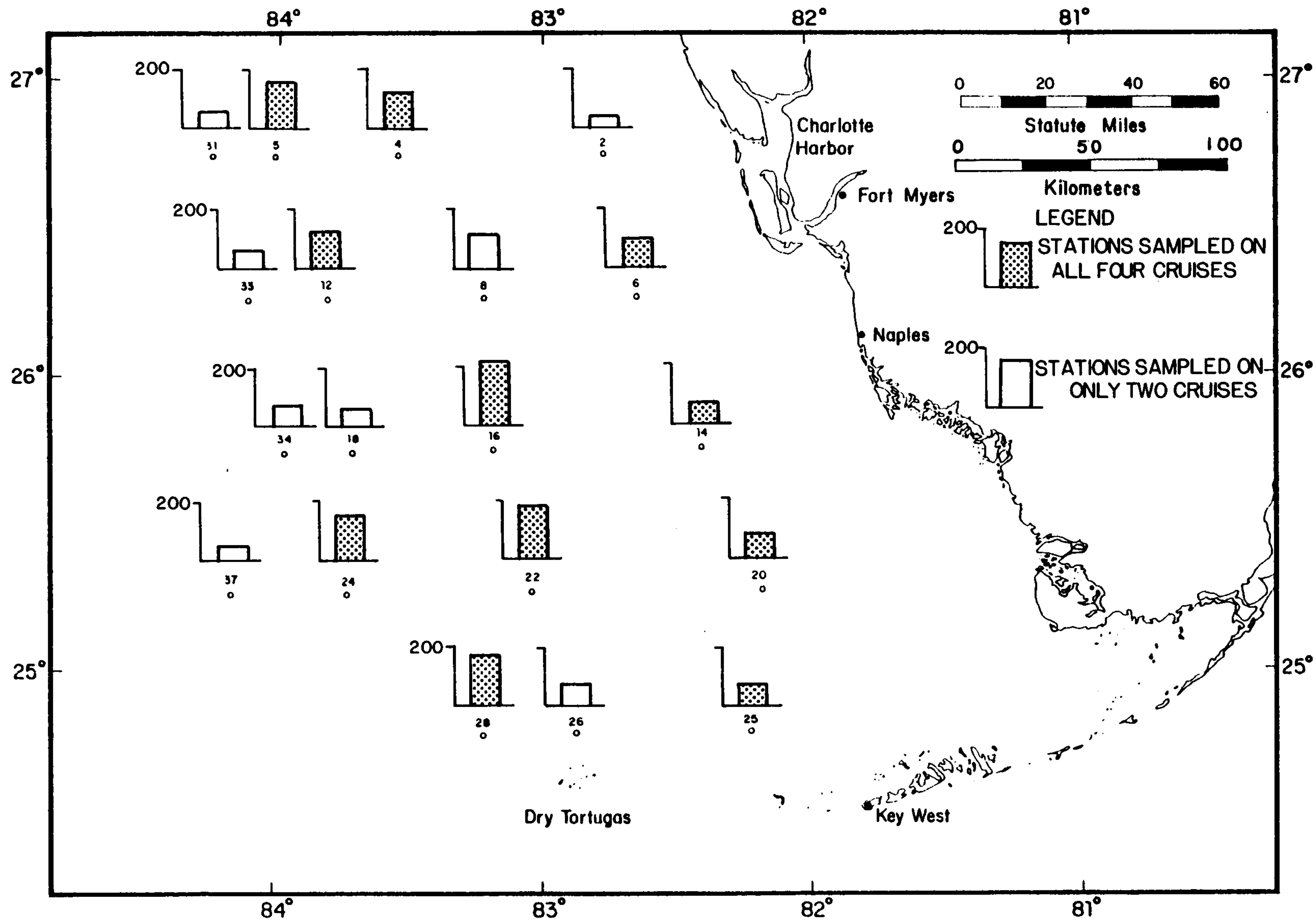


Figure 7-12. Shelfwide variation in the number of total taxa (identified to genus or species) collected by otter trawl sampling at soft bottom stations.

Stations 14, 18, and 26. Figure 7-13 summarizes the inferred habitat type at each soft bottom station, based on the composition of trawl catches. The designation of "moderate to thick" or "scattered" live bottom is only by comparison to thick sand and other soft bottom substrates; all soft bottom stations supported at most a very sparse live bottom epibiota in comparison to that present at live bottom stations.

7.4.2.3 Cluster Analysis

Results of the cluster analysis for the Fall Cruise are illustrated in Figure 7-14. Two major cluster groupings were evident (nearshore and offshore), and there were several distinguishable subgroupings. The nearshore zone consisted of three stronger clusters: the first, Station 20 alone; the second, Stations 25 and 26; and the third, Stations 2, 6, and 14. The offshore cluster consisted of two major subclusters. The first consisted of four components: Stations 8, 16, 22, and 28; and Station 4 (which was somewhat dissimilar to the other four stations). The second consisted of Stations 5, 12, 18, and 24. The major nearshore offshore clusters separate the stations into two distinct areas--i.e., stations between the 20 and 40m depth contours, and stations between the 40 and 100m depth contours.

Results of the cluster analysis for the Spring Cruise are illustrated in Figure 7-15. As for the Fall Cruise, there were two major clusters, separating the stations into nearshore and offshore groups. The nearshore zone was made up of two major subclusters, each composed of two subsets of stations. The first subcluster was composed of Station 2 alone and Stations 14 and 20 and the second of Station 25 alone and Stations 6 and 26. The offshore zone was composed of two major subclusters. The first subcluster contained Stations 5, 12, and 18 and the second, Stations 4, 8, 16, 22, and 28.

Results of the cluster analysis for the Summer Cruise are presented in Figure 7-16. Three major cluster groupings were evident--nearshore, intermediate, and offshore, with the offshore group being the most distinct. The intermediate (Stations 4, 5, 16, 22, 24, and 28) is equivalent to the offshore group of the Year One cruises and the occurrence of a third group corresponds to the inclu-

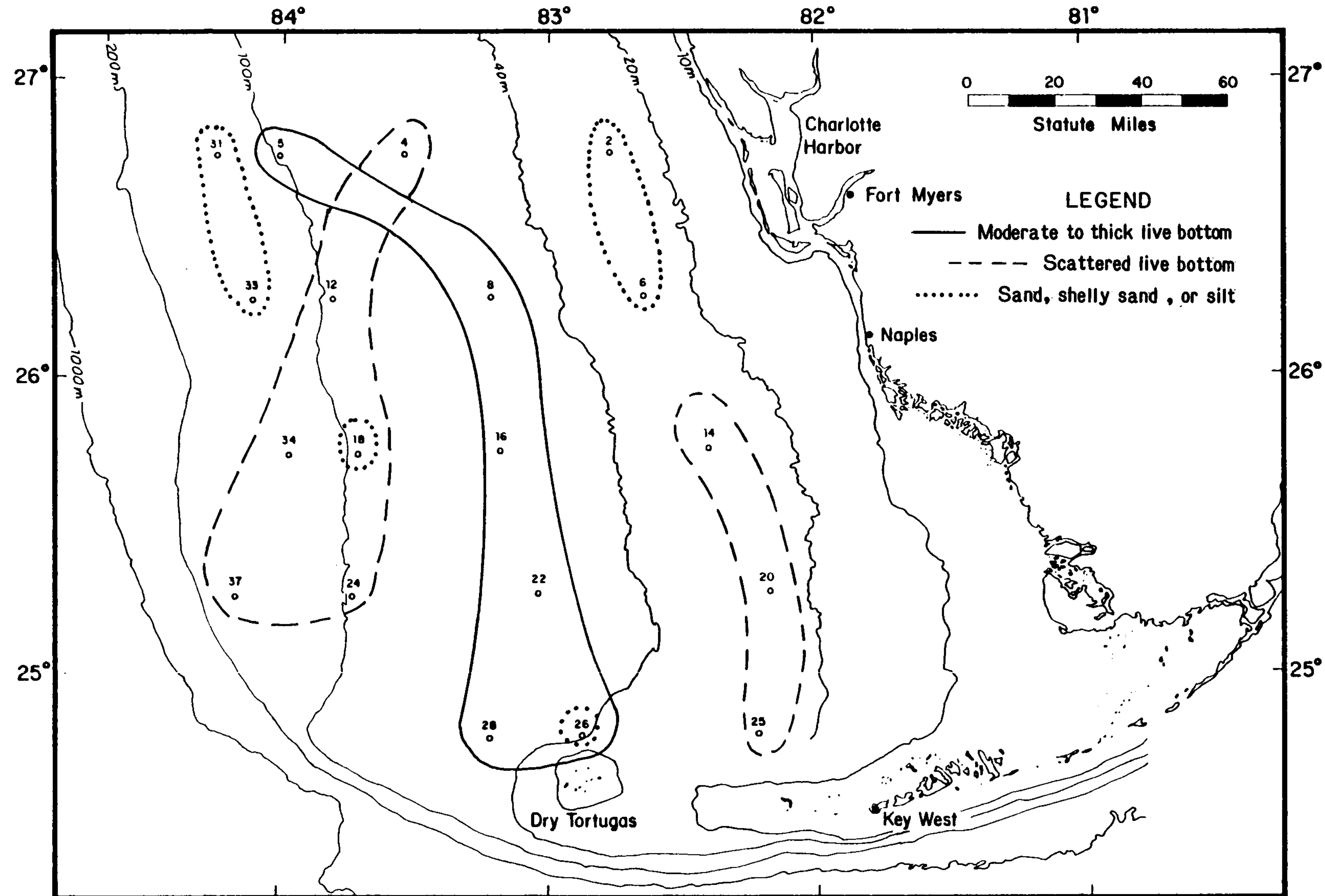


Figure 7-13. Inferred presence of live bottom at soft bottom stations, based on substratum affinities of macroepifauna collected in trawls.

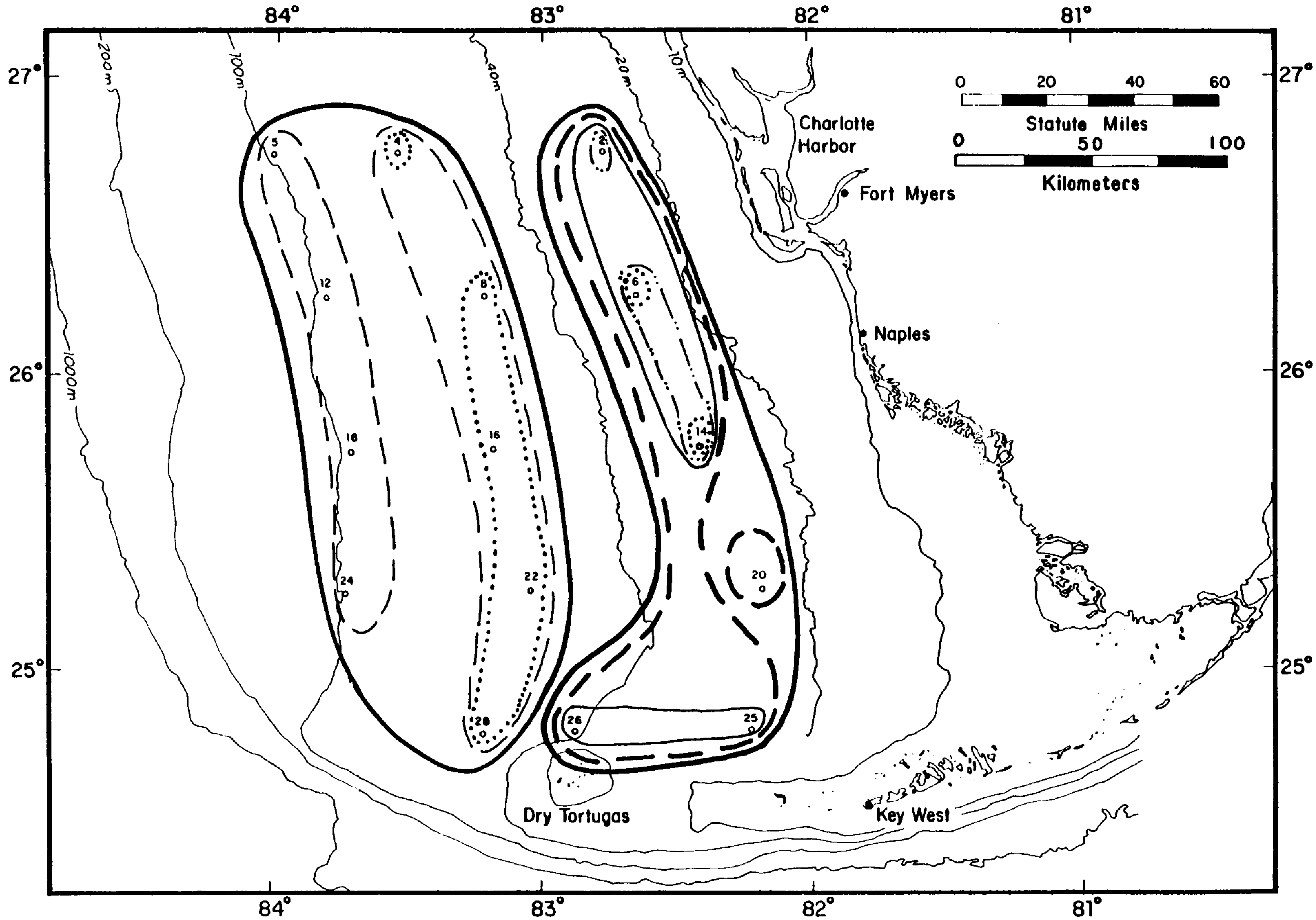


Figure 7-14. Stations groupings based on cluster analysis of otter trawl data, Fall Cruise.

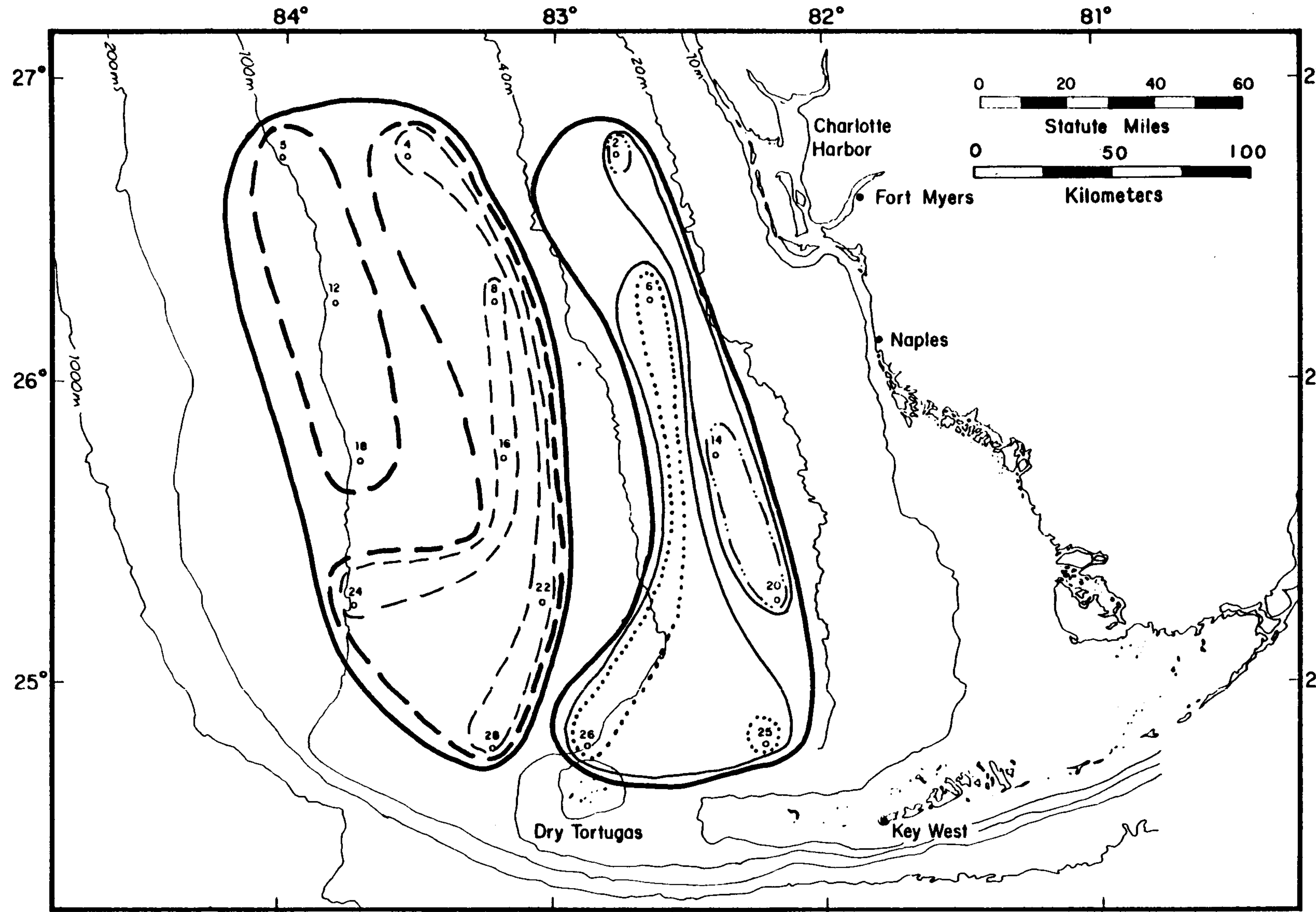


Figure 7-15. Station groupings based on cluster analysis of otter trawl data, Spring Cruise.

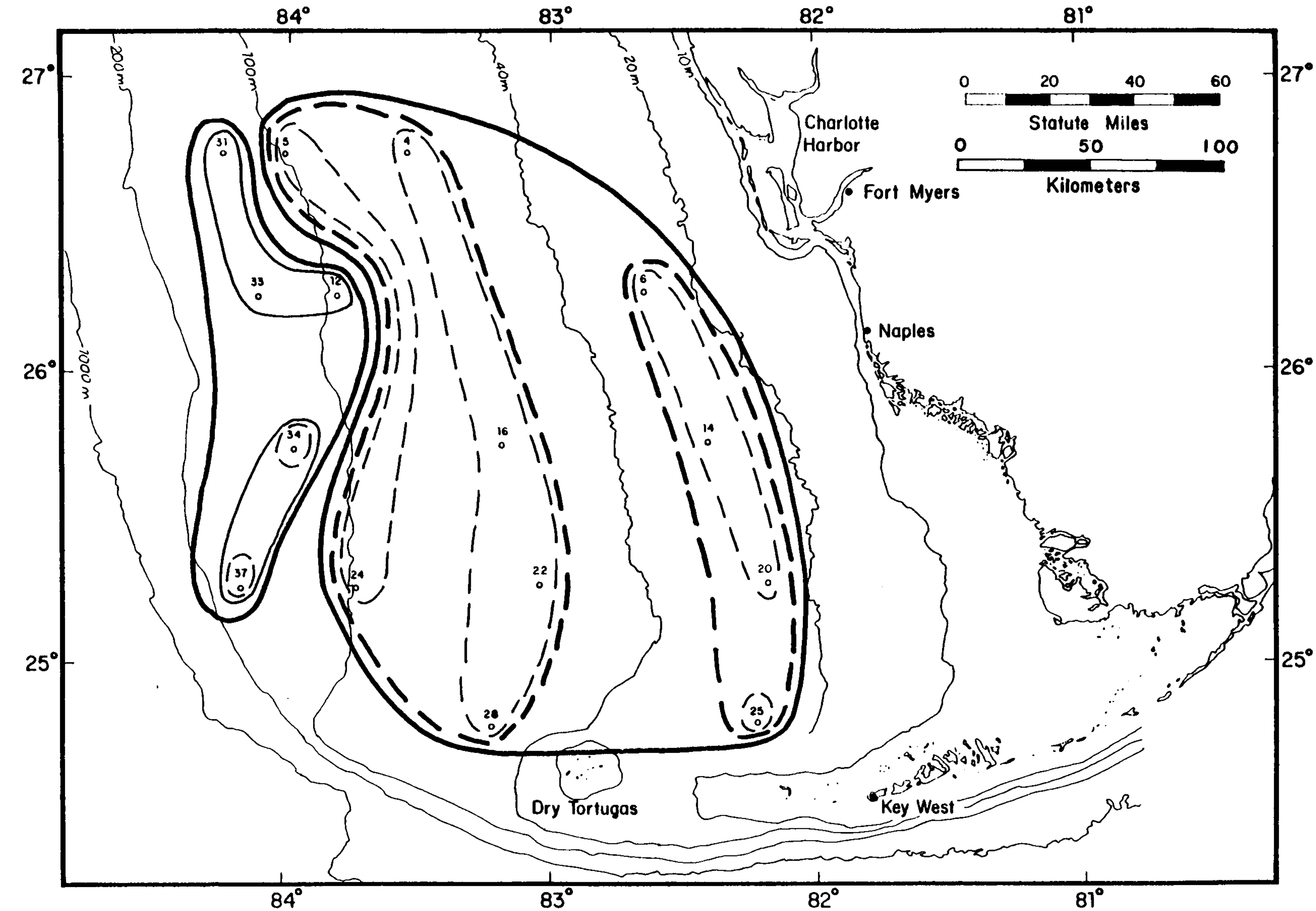


Figure 7-16. Station groupings based on cluster analysis of otter trawl data, Summer Cruise.

sion of the four additional deepwater (>100m) stations for the Year Two surveys. The offshore group, as distinguished by the otter trawl samples, consisted of two major subclusters. The first of these was composed of Stations 12, 31, and 33, and the second was composed of Stations 34 and 37. Two major subclusters constituted the intermediate group, the first consisting of Stations 5 and 24 and the second Stations 4, 16, 22, and 28. The nearshore group encompassed Stations 6, 14, 20, and 25; Stations 25 was dissimilar to the others within this group.

Results of the cluster analysis for the Winter Cruise are presented in Figure 7-17. There were only two major clusters rather than the three groups of the Summer Cruise. The offshore zone consisted of two major subclusters, one containing Stations 31, 33, 34, and 37, and the second consisting of Stations 5, 12, and 24. Within the large nearshore group, Station 25 was distinct from all other stations, which fell into two subgroups: one containing Stations 4, 16, 22, and 28 and the other Stations 6, 14, and 20.

The results for the cluster analysis for all cruises combined are presented in Figures 7-18 and 7-19, and two-way tables of species occurrence are presented in Table 7-64. As for the individual cruises, there were three major station clusters distinguishing nearshore, intermediate, and offshore zones. The offshore zone consisted of Stations 31, 33, 34, and 37. However, Summer Cruise data for Stations 5, 12, and 24 also clustered with these stations. The intermediate zone was composed of a number of subclusters, the two largest of these separated the zone into two groups of stations at different depths. The nearshore zone also constituted a number of subclusters, which primarily resolved the unique nature of two station combinations (e.g., 25 and 26, or 14 and 20), or single stations that seemed to be unique (e.g., Station 6). The level of "seasonal" variability was higher than for the box core clustering; rarely did all seasonal samples for a particular station cluster closely, and two stations (Stations 5 and 12) exhibited enough seasonal variability to appear in more than one major cluster.

Table 7-65 lists taxa that were characteristic of particular station groupings from cluster analysis of otter trawl data. As discussed in Section 7.4.2.2,

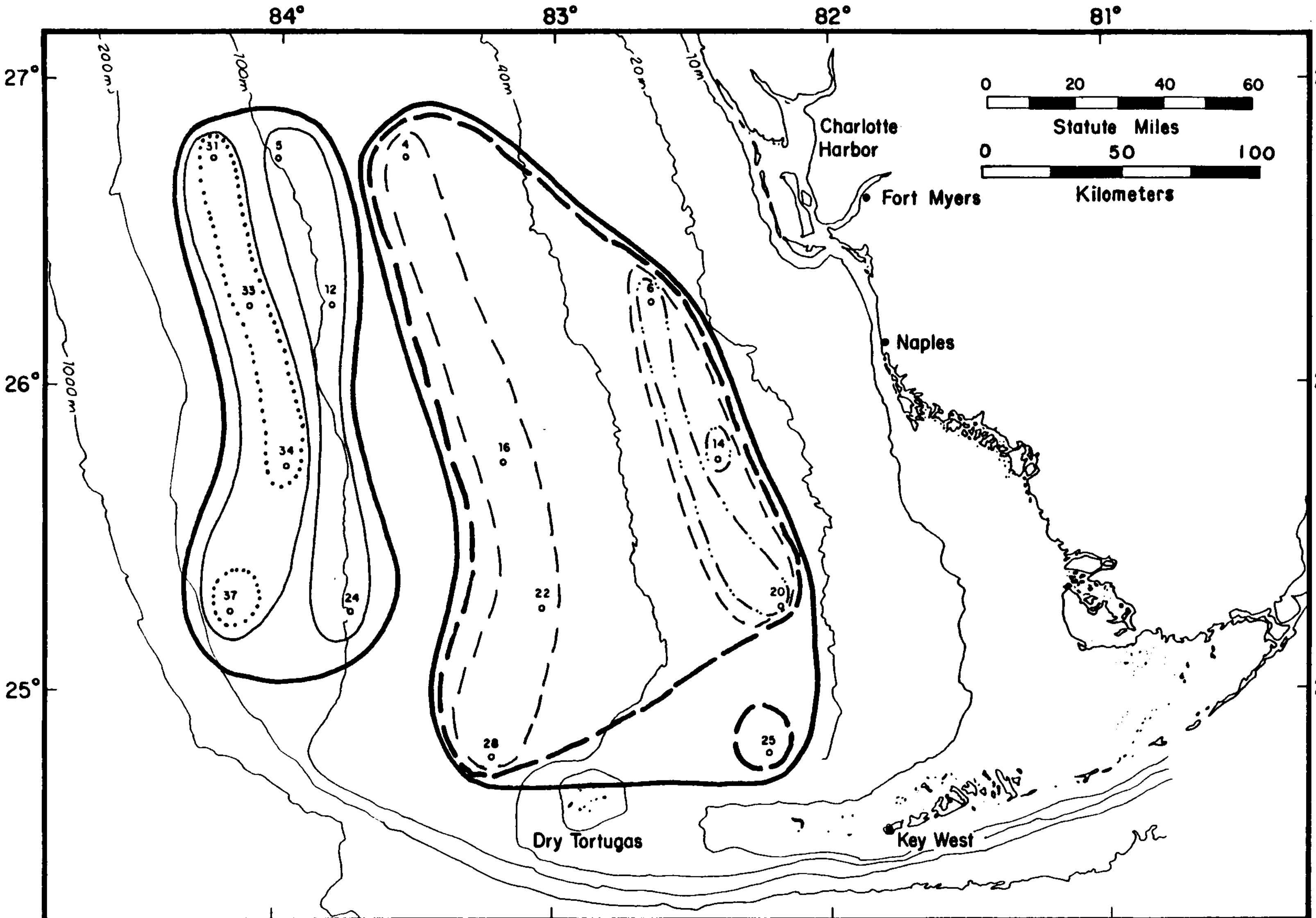


Figure 7-17. Station groupings based on cluster analysis of otter trawl data, Winter Cruise.

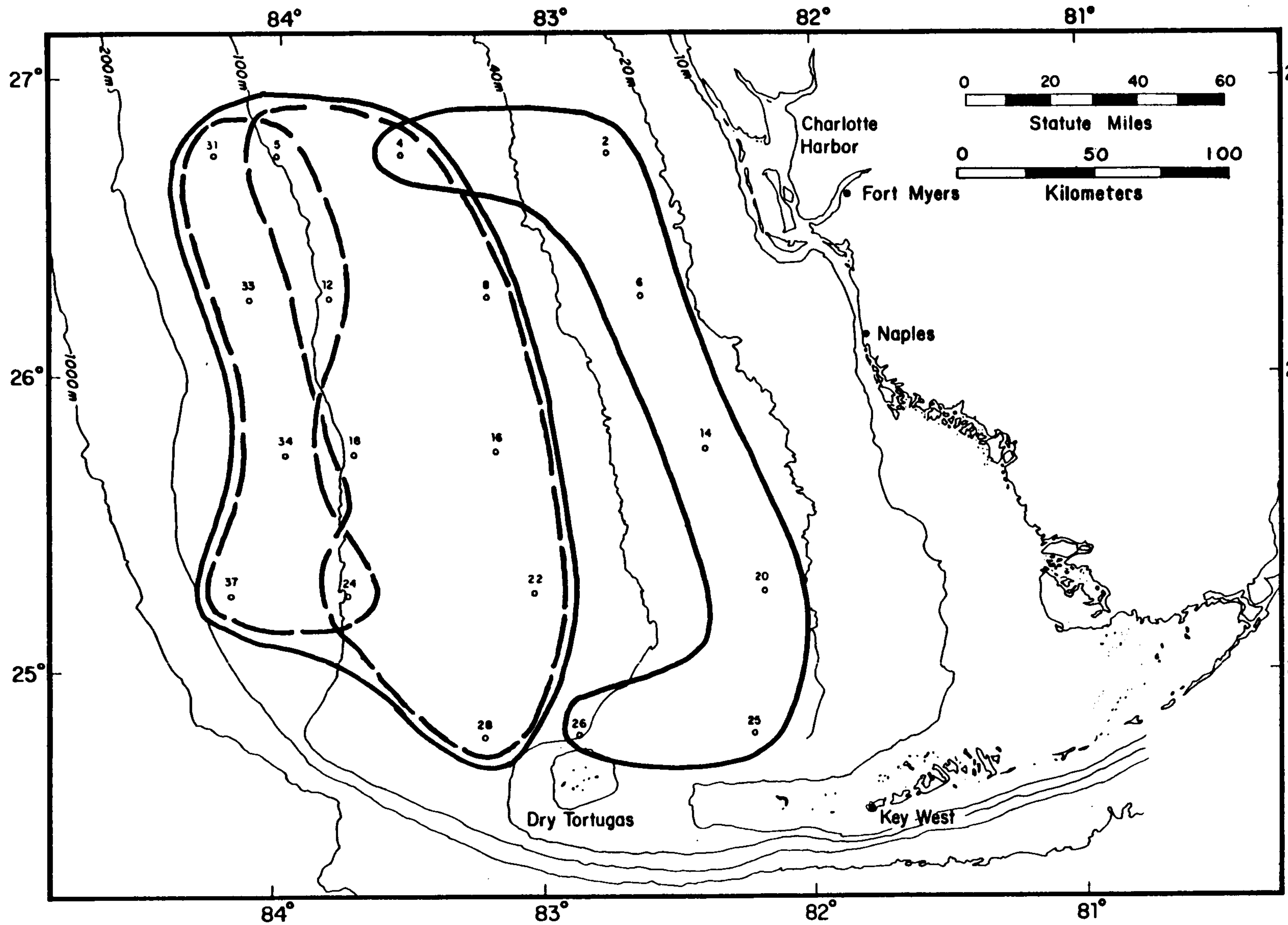
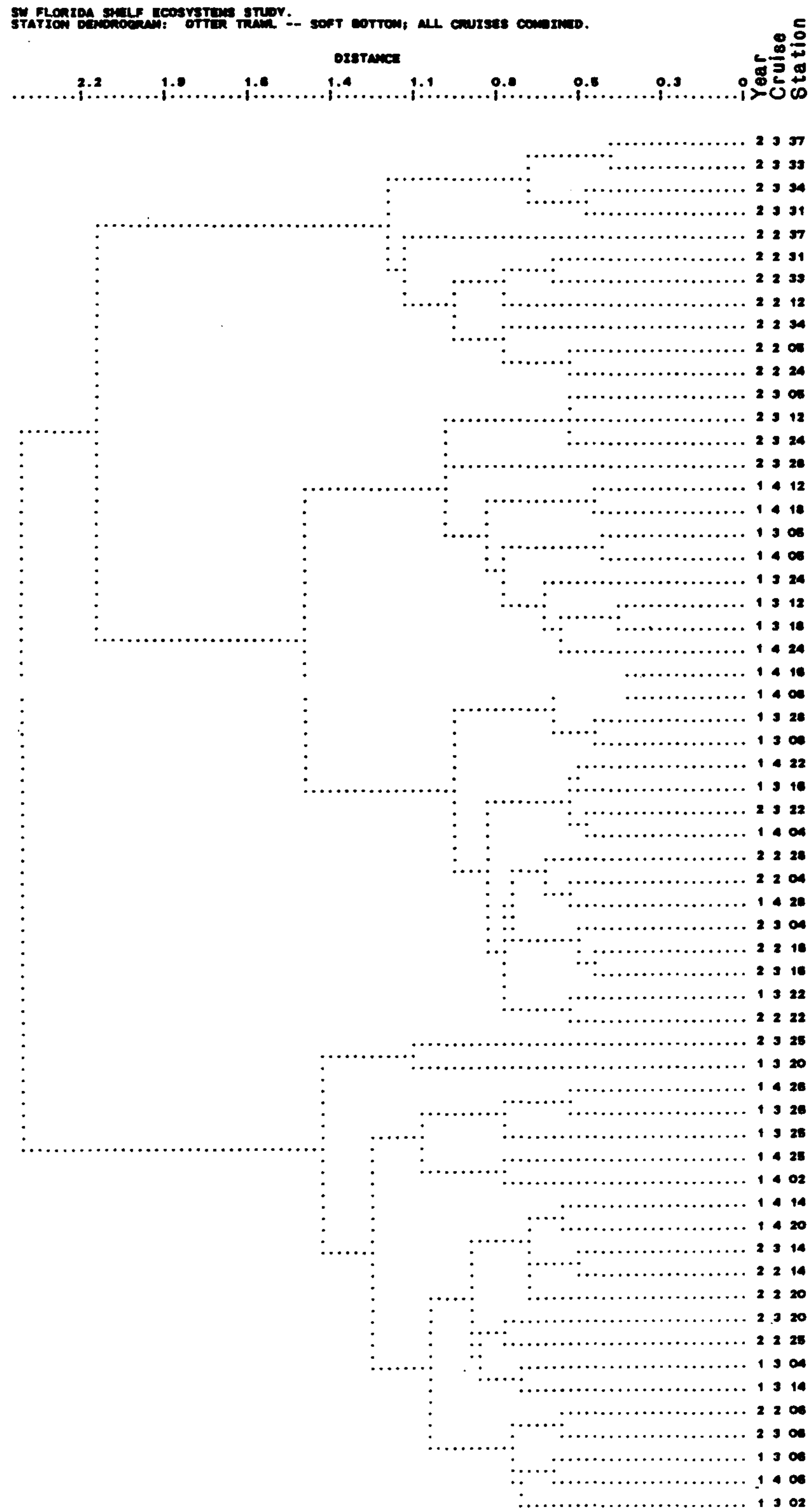


Figure 7-18. Simplified station groupings based on cluster analysis of otter trawl data, all cruises combined.



NOTE: YEAR 1, CRUISE 3 = FALL CRUISE (OCTOBER 25-NOVEMBER 23, 1980); YEAR 1, CRUISE 4 = SPRING CRUISE (APRIL 22-MAY 5, 1981); YEAR 2, CRUISE 2 = SUMMER CRUISE (JULY 16-AUGUST 5, 1981); YEAR 2, CRUISE 3 = WINTER CRUISE (JANUARY 28-FEBRUARY 15, 1982).

Figure 7-19. Station dendrogram from cluster analysis of otter trawl data from all soft bottom stations, all cruises.

Table 7-64. Two-way table of station/season occurrences of taxa from cluster analysis of otter trawl data from soft bottom stations, all cruises combined.

```
                         YEAR     2 2 2 2 2 2 2 1 1 1 1 1 1 1 2 2 1 2 1 2 1 1 1 1 2 2 1 2 1 1
                         CRUISE   3 3 2 2 2 3 3 4 3 3 3 4 3 4 3 2 4 2 3 3 4 3 4 4 2 3 3 2 3 3
                         STATION  3 3 3 1 0 0 2 1 0 2 1 1 2 2 2 2 2 1 2 2 2 2 0 2 1 2 0 0 0 0
                                  3 1 1 2 5 5 4 2 5 4 8 6 8 2 2 8 8 6 2 5 6 5 2 0 4 0 4 6 6 2
                        YEAR     2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 2 2 2 2 1 1 1 1 2 2 2 1 2 1
                        CRUISE   3 3 2 2 2 2 3 3 4 4 3 4 4 3 3 4 2 3 3 2 3 3 4 4 3 2 2 3 3 4
                        STATION  3 3 3 3 3 2 1 2 1 0 1 2 0 0 1 0 0 0 1 2 2 2 2 1 1 2 2 1 0 0
                                 7 4 7 3 4 4 2 8 8 5 2 4 8 8 6 4 4 4 6 2 0 8 5 4 4 0 5 4 6 6

                                 123456789012345678901234567890123456789012345678901234567890
CITHARICHTHYS CORNUTUS           ---- ---- -    -
SCORPAENA AGASSIZI               ---- -  -- -  -
BELLATOR EGRETTA                 ---     -  -     -    -
SYNODUS SYNODUS                  -- -        ---                   -
PRIONOTUS STEARNSI               --   -   -      ----              -
SAURIDA BRASILIENSIS             --     - -    -  -             -  -         -
CARAPUS BERMUDENSIS                   ---  -         --                             -
COMACTINIA MERIDIONALIS           --   - ---- -                  -                   -
SAURIDA NORMANI                   - - ---  - -  --  ----       -
ILIACANTHA SUBGLOBOSA             ---  -- - ---        ---            -
MESOPENAEUS TROPICALIS             --       --     - ---
MUNIDA SIMPLEX                   ----             -- -  - - -
CALAPPA SULCATA                  ------- --  --   -                       -
PALICUS SP.                      ----- - --       ---   --      -                         -
PORTUNUS SPINICARPUS              -------------   -----  ---    -    --   --              -
STYLOCIDARIS AFFINIS             --  -  --- --- -------   -      -  --                -
PARTHENOPE AGONA                  -  - -  --- -  -  -------         -                  -
LOLIGO PEALEII                    -  --   --   -                   ---           -  -
LOLIGO SP.                           -       --                    -                --  -
SICYONIA SP.                         -                  --        -       -  -             -
PORTUNUS SP.                         -    -- - -  -- - --- --  -    -     -  ----   -     --
OCTOPUS VULGARIS                     -                     - -- --  - --                  -
SYACIUM GUNTERI                                                           ----- -    -
SICYONIA TYPICA                                        -                 - --            ---
PORTUNUS GIBBESI                                         -                  - -    - - ------
PENAEUS DUORARUM                                       - --       -       ----       - -  ---
HALICLONA COMPRESSA                                         ---     --  - - -  --   -
PARTHENOPE GRANULATA                         -          -- -             --    -    --  -- -
PORICHTHYS PLECTRODON                   -   ---         --          - --- ----       -    --
LEPOPHIDIUM GRAELLSI               -- ---  -         - -            -  -  ---
ASTROPECTEN SP.                   --- -     -             -      -  - --   - --- -     - --
SQUILLA RUGOSA                     -         --                                     -   ----
OPHIDION HOLBROOKI                      -  -         ----                           -    ---
DIPLECTRUM BIVITTATUM                               -      -          -   ----     -   ----
HAEMULON AUROLINEATUM                                    - -              ---           ---
LOLIGO PLEI                                              ---     --   -    ---          -
PODOCHELA SIDNEYI                            -          - -  -   -         -  -
APOGON PSEUDOMACULATUS                        ---     -   ---       - -    --
LAEVICARDIUM PICTUM                                     --      ---       -              -
OGCOCEPHALUS RADIATUS                        - --                                 - -   - -
SPHOEROIDES SPENGLERI                     -                  --                - - --  -
PRIONOTUS SALMONICOLOR              -          -              -    -                  -  -  -
FAUCHEA SP.                                             --     -              -       -   - -
EQUETUS LANCEOLATUS                                     - --  --    -- -           -   -    -
HALIMEDA DISCOIDEA                                -    ---- - -  -           -       --    -
MONACANTHUS HISPIDUS                    -           -   - ------ --- --  -      - --  - --- -
PORTUNUS SPINIMANUS                            -  -       --- ---- ---    ---  - ------------
DIPLECTRUM FORMOSUM                          -          -  ---   -------    - --------- -----
BOTHUS ROBINSI                                          -- ------ ------       ----    ---- -
SICYONIA BREVIROSTRIS                                ------    --------  -- -      -  - ----
METAPENAEOPSIS GOODEI                                   ---- -   -  -- -  -           -- ----
SERRANUS PHOEBE                  ----        -          -------- -  -     -
UROPHYCIS FLORIDANUS                  -- -   -          --   - - -  --
SQUILLA SP.                       - -   -     -        - - -    -    - -        -          -
SYMPHURUS DIOMEDIANUS             -        -        -  --- -    -   --    --           -- -
PROCESSA TENUIPES                  --  -    ---      ---- --        -- -                 --
SOLENOCERA ATLANTIDIS               -  -    ---     --- ----     - -----  --          - -- -
GYMNOTHORAX SAXICOLA                   -- --  -   - ------------ -- ----  ---            -
LEPOPHIDIUM JEANNAE                   - -   --          --           --                   --
SYNALPHEUS TOWNSENDI                    - - -      -    --   -     ---      -
PROCESSA VICINA                                         ----     - - -   -            -
SYACIUM PAPILLOSUM                  - ----------------------------------   - ------------- -
SYNODUS FOETENS                           -     ----- - - ------     -    -  ------  -------
ECHINASTER SP.                              - --------  --- --------  -   -   ---  -- --  --
MONACANTHUS CILIATUS                       -   -----    -----------------       --------
HIPPOCAMPUS ERECTUS                       --  ---- --- ----  ---------                      -
TRACHINOCEPHALUS MYOPS                    - --    - - - -    ---  ---- -        -  -   -- -
CENTROPRISTIS SP.                      -- --   -              - -- ---
VERMICULARIA KNORII                     - - -- -              - -  --
ECHINASTER MODESTUS                       ---- -                 - --  -          -     --
SYNODUS SP.                               --                -    --  - -             -
POLYCARPA CIRCUMARATA                     ---                    -  -- -
PRIONOTUS PARALATUS                        -     ------                       -         -
```

Table 7-64 (Continued)

```
ATHENOIDES PIERCEI                     -  - --   -----  ---  -                -
CITHARICHTHYS SP.                      ---        -      --          -                             -
STENOCIONOPS SPINIMANA                 --         -- --  -
CARPOPORUS PAPULOSUS                       --     - -  -   -      -       -
CITHARICHTHYS GYMNORHINUS                  --  -----  --  - --   - -                      -
HALIEUTICHTHYS ACULEATUS      ----  ---  -----------------------------------   -      -
OGCOCEPHALUS PARVUS               -      -----   -- -   - ----   ----
SCORPAENA BRASILIENSIS         --    -    ----- --- -----  -------------                   --   -
SYNODUS INTERMEDIUS                   ---  -------  -------------  -----                -  - - -
STENORHYNCHUS SP. A                    ---   ---  -- -----  -  -  ---  --           -    -  -    -
POLYCARPA OBTECTA                     -   -- ---  --------  -   --------  --                  -
BELLATOR MILITARIS                         ----    - ---------    - -  -------                    -
PODOCHELA LAMELLIGERA                      - -     -----  ---   --   -
CENTROPRISTIS OCYURUS                             ---- ----------  -   -     -                 -
COLLODES TRISPINOSUS           -                    - -    -- -           -                    -
AGARICOCHIRUS SP.               -          -      -  --        - -      -
MUREX CABRITII                               - -    -   -     -  -      - -
SPHOEROIDES DORSALIS                         ----   - - -------  -      -  -                  -  -
TOZEUMA SERRATUM                             ---    -  --  -- -  -      -- --                 -   -
STENORHYNCHUS SETICORNIS        -             -      --  - ----  -   -  -  --                     -
MICROCIONA SPP.                              ---     -      --- -         --
GALATHEA ROSTRATA                            -         -   -----        - --
STENOCIONOPS FURCATA COELAT                 --     -       -    - - ---  --  -                 -
PRIONOTUS ROSEUS                       -                   -----  --  - ----    -           ---
SCORPAENA CALCARATA                          -      -- -   ------------------    -    -     - -- -
SCYLLARUS CHACEI                                    -         -------- ---   ---   --          -
PODOCHELA GRACILIPES                        -      -   -   - --     -       -              -
CAULERPA SERTULARIOIDES                               -  ---------     -    -         -       --   -
ANTHOSIGMELLA VARIANS                                        -      ---    -----         -     -     -- -
LACTOPHRYS QUADRICORNIS                                        -   -    ----  -               -   - --
APOGON AUROLINEATUS                                            --  -       -  -     -                -
ANTENNARIUS OCELLATUS                          -                --- -  -    --
DROMIDIA ANTILLENSIS                          -    --     -   - ---  --  --  -               -
SCYLLARIDES NODIFER                                  -     -    -- -  -   --
SPIRASTRELLA COCCINEA                          -   -      ---   ---    ----
? FORCEPIA SP.                                 -          - -   --        ---
OCTOPUS JOUBINI                                            -----   -   --
RYPTICUS BISTRISPINUS                                     - -  --  - -  - --                -
IRCINIA STROBILINA                                        - -   --    -  -  -
                              1234567890123456789012345678901234567890123456789012345678901234567890
```

SYMBOL DEFINITIONS: ( )= ABSENT; (-) = PRESENT.

NOTE: YEAR 1, CRUISE 3 = FALL CRUISE (OCTOBER 25-NOVEMBER 23, 1980);
YEAR 1, CRUISE 4 = SPRING CRUISE (APRIL 22-MAY 5, 1981);
YEAR 2, CRUISE 2 = SUMMER CRUISE (JULY 16-AUGUST 5, 1981);
YEAR 2, CRUISE 3 = WINTER CRUISE (JANUARY 28-FEBRUARY 15, 1982).

Table 7-65. Trawl-collected taxa that were characteristic of particular station groupings from cluster analysis, soft bottom stations.

I. **Offshore** (Stations 4, 5, 8, 12, 16, 18, 22, 24, 28, 31, 33, 34, and 37)--Depth Range 48 to 148m

Portunus spinicarpus (decapod)
Stylocidaris affinis (decapod)
Parthenope agona (decapod)

I.A. Stations 5, 12, 24, 31, 33, 34, and 37--Depth Range 88 to 149m

Calappa sulcata (decapod)
Citharichthys cornutus (fish)
Comactinia meridionalis (crinoid)
Saurida normani (fish)
Scorpaena agassizi (fish)

I.B. Stations 4, 8, 16, 22, and 28--Depth Range 48 to 59m

Dromidia antillensis (decapod)
Octopus joubini (cephalopod)
Prionotus roseus (fish)
Rypticus bistripinus (fish)
Scorpaena calcarata (fish)
Scyllarides nodifer (decapod)
Scyllarus chacei (decapod)

II. **Inshore** (Stations 2, 6, 14, 20, 25, and 26)--Depth Range 23 to 38m)

Diplectrum bivittatum (fish)
Haemulon aurolineatum (fish)
Penaeus duorarum (decapod)
Portunus gibbesi (decapod)
Sicyonia typica (decapod)
Syacium gunteri (fish)

---

macroepibiotal assemblages at mid to outer shelf depths were characterized by a mixture of live bottom and soft bottom species. The major "break" in the station dendrogram (Figure 7-19) was between nearshore (2, 6, 14, 20, 25, and 26) and offshore (all others) stations. Species characteristic of the nearshore grouping are all typical of sand or mud habitats; penaeid shrimps, including the pink shrimp *Penaeus duorarum*, would be expected to be characteristic of Stations 25 and 26 (located within the Tortugas pink shrimp grounds) and Station 6 (located within the Sanibel grounds). In contrast, the mid shelf Stations 4, 8, 16, 2, and 28 were characterized by macroepifauna that are typically associated with reef, rocky, or live bottom habitats, including the crustacean *Dromidia antillensis* (which was among the most frequently collected crustaceans at live bottom stations), the scorpionfish *Scorpaena calcarata*, the cephalopod *Octopus joubini*, and the scyllarid lobsters *Scyllarus chacei* and *Scyllarides nodifer*. Both of the scyllarids were reported to be abundant at similar depth ranges in the Hourglass study collections, occurring primarily on sponge/coralline algae/shell bottom (Lyons, 1970). Among the macroepibiota characteristic of outer shelf stations, the crinoid *Comactinia meridionalis* and the scorpionfish *Scorpaena agassizi* were also typical of outer shelf live bottom stations (see Section 6.4), and combined cluster analyses suggest that the outer shelf live and soft bottom macroepibiota are more similar than their mid shelf and nearshore counterparts (see Section 8.2.3).

7.4.3 Epiflora: Collections & Photographic Observations

The abundance and taxonomic composition of macroalgal assemblages were examined by two approaches. First, still camera photographs were examined for the presence of macroalgae at each station. Second, macroalgae were identified from otter trawl and box core samples; although a few macroalgal taxa were included in the otter trawl cluster analysis in Section 7.4.2, that section did not specifically focus on epiflora.

Photographic Analysis -- Values of the average percent incidence of macroalgae for both years (cruises combined by year), defined as the percent of the still camera photographs in which macroalgae were present, are shown in Figures 7-20 and 7-21. For Year One (Fall and Spring Cruises), these values ranged from

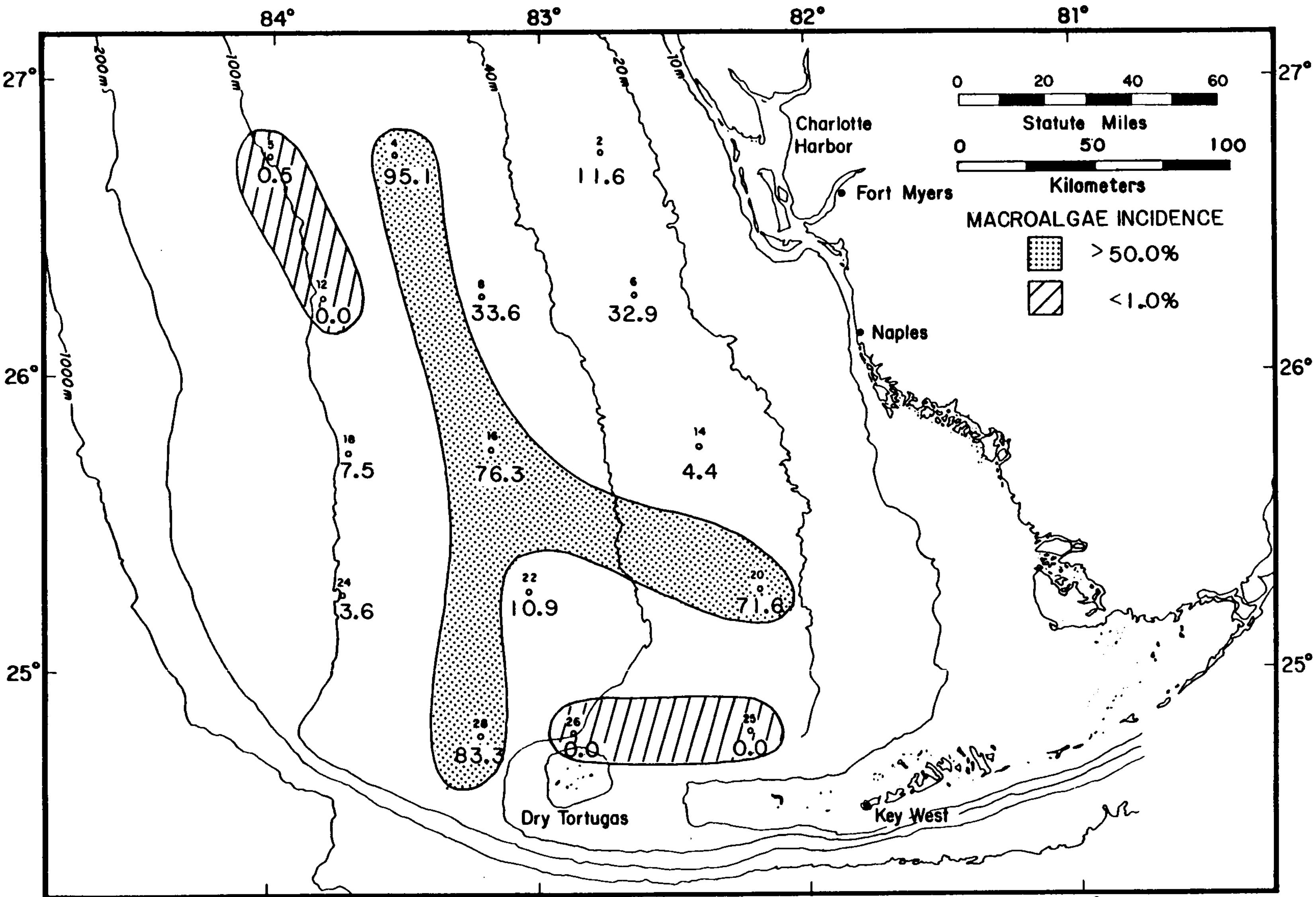


Figure 7-20. Percent incidence of macroalgae in bottom photographs at soft bottom stations during Year One. Values represent photographs with algae as a percentage of all photographs examined, averaged over the two Year One (Fall, Spring) cruises.

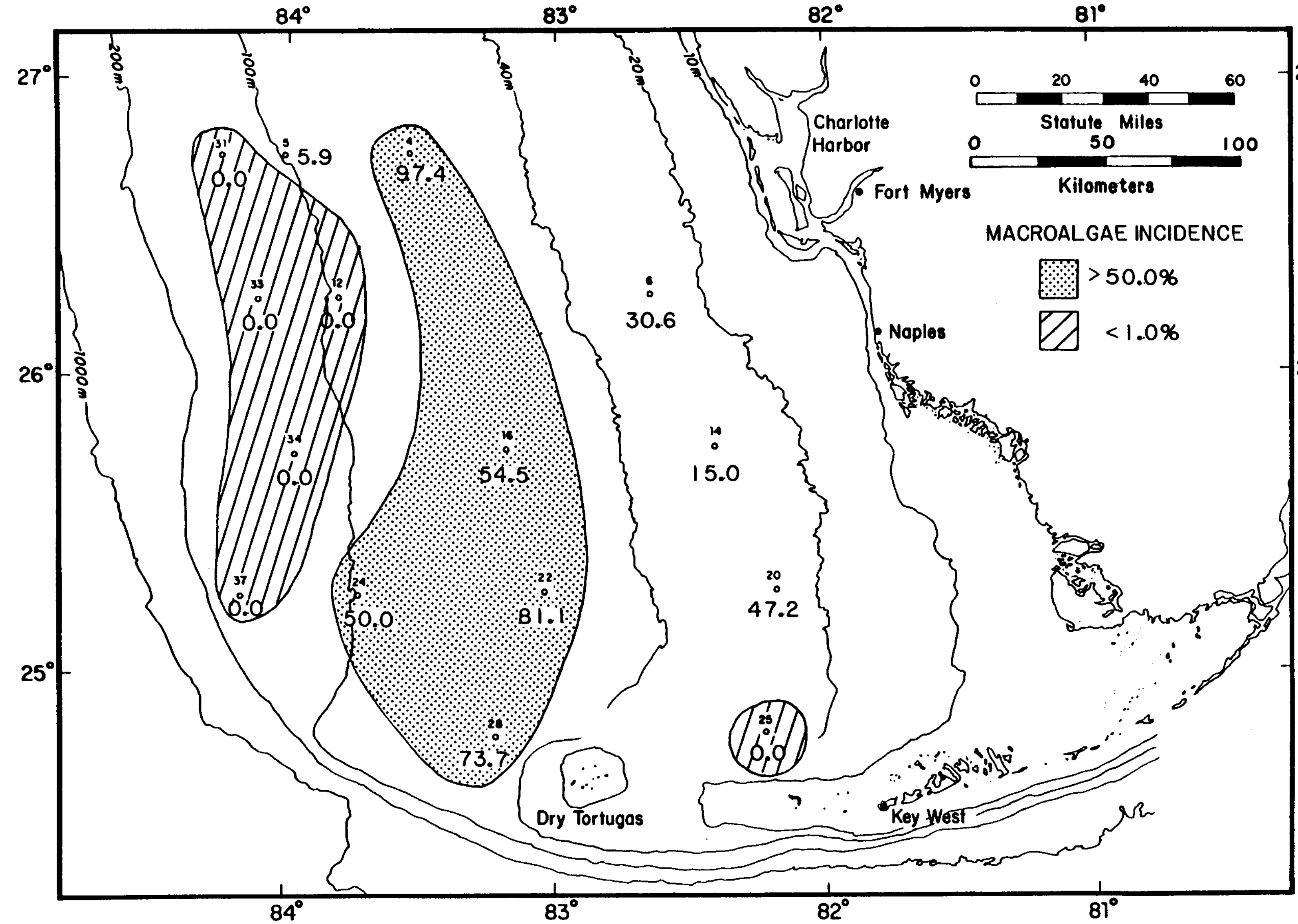


Figure 7-21. Percent incidence of macroalgae in bottom photographs at soft bottom stations during Year Two. Values averaged over the Year Two (Summer, Winter) cruises.

95.1% at Station 4 to 0% at Stations 12, 25, and 26. At Station 25, high turbidity (low visibility) hindered macroalgae observations. All three of the stations at which macroalgae were absent had substrates consisting of very fine sands with a high percentage of silt/clay-sized particles and a high calcium carbonate content. For Year Two, values ranged from 97.4% at Station 4 to 0% for Stations 12 and 25 (as in Year One), as well as the additional deep Stations 31, 33, 34, and 37. The deep (>100m) Stations 31, 33, 34, and 37 were apparently at the limit of the photic zone, as no algae were seen in the photographs from either of the Year Two cruises (although a few were collected in the trawls). The incidence of different macroalgae in bottom photographs for each station is presented in Tables 7-66 (Year One) and 7-67 (Year Two). A greater number of species were discernible from the Year Two photographs. Twelve stations (of 15 total) exhibited algal presence for Year One, while nine stations had detectable algae for Year Two (due to the deletion of Stations 2, 8, and 18). For both years, the _Caulerpa_ species complex was the most ubiquitous, occurring at 10 of 12 stations for Year One and 7 of 9 stations for Year Two, and occurring in relatively large percentages of photographs. _Halimeda discoidea_ and _Udotea_ and _Udotea_-like species were also common in bottom photographs.

Trawl & Box Core Collections -- A total of 21 algal taxa (identified to genus or species) were identified from the trawl and box core samples for both years. Of these, 19 were identified to species and 2 to genus level; in addition, addition, several unidentifiable but distinct fragments and an unidentified blue-green alga were collected. (These results compare with 106 genus- or species-level taxa identified from live bottom stations.) Algae were collected at 9 of the 15 stations from Year One, and at all 15 stations from Year Two. However, the catches at Stations 31, 33, 34, and 37 were minimal, consisting primarily of the brown alga _Sargassum hystrix_. The bottom photographs revealed no algae at these stations, which are believed to be at the limit of the photic zone.

Cruise-by-cruise catch records from soft bottom stations are presented in Tables 7-68 through 7-71. The total number of macroalgal taxa collected (summed over stations) varied from 7 (Spring Cruise) to 17 (Summer Cruise), with 11 taxa collected on each of the other two cruises. Some variation in catches of

Table 7-66. Percent incidence (number of photographs in which taxa were present as a percent of all photographs examined) of macroalgae in still-camera photographs from soft bottom stations, Year One (Fall and Spring Cruises) only.

Taxon	Station											
	2	4	5	6	8	14	16	18	20	22	24	28
Caulerpa spp.	15	6	1	97	91	71	89	0	77	71	0	81
Halimeda discoidea	10	95	0	0	13	0	25	0	3	0	0	23
Udotea & like species	5	1	0	0	1	0	1	0	6	0	40	0
Unid. Chlorophycophyta	50	25	0	3	6	29	4	23	22	17	20	13
Unid. Rhodophycophyta	15	3	0	0	0	0	0	0	0	0	0	0
Unid. Phaeophycophyta	0	1	0	0	0	0	0	0	0	0	0	0
Mixed Rhodophycophyta & Phaeophycophyta	10	8	0	0	0	0	3	77	0	14	40	1

Table 7-67. Percent incidence (number of photographs in which taxa were present as a percent of all photographs examined) of macroalgae in still-camera photographs from soft bottom stations, Year Two (Summer and Winter Cruises) only.

Taxon	Station 4	5	6	14	16	20	22	24	28
Caulerpa cf. *mexicana*	0.0	0.0	0.0	0.0	0.0	34.4	0.0	0.0	0.0
C. prolifera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
C. sertularioides	9.2	0.0	3.9	28.1	44.9	0.6	20.4	0.0	15.6
Cladophora sp.	0.0	0.0	0.0	0.0	0.0	0.0	19.8	0.0	49.7
Fauchea peltata	29.7	5.9	0.0	0.0	2.1	0.0	1.7	0.0	45.9
Filamentous green-algal mat	0.0	0.0	62.8	0.0	0.0	0.0	0.0	100.0	0.0
Halimeda discoidea	65.1	0.0	0.0	0.0	27.1	20.3	1.8	0.0	15.8
Halymenia-like Rhodophycophyta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.8
Padina sp.	17.9	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0
Pseudocodium sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.1
Udotea conglutinata	0.0	0.0	0.0	0.0	0.0	50.5	0.0	0.0	0.0
Udotea-like Chlorophycophyta	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	2.2
Ulva lactuca	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ulva-like Chlorophycophyta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.8
Unidentified Phaeophycophyta	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7-68. Occurrence of macroalgae in trawl and box core samples from soft bottom stations on the Fall Cruise.

Taxon	Station											
	2	4	5	6	8	12	14	16	20	22	24	28
CHLOROPHYCOPHYTA												
Caulerpa sertularioides		+		+	+		+	+		+	+	+
Halimeda discoidea	+	+			+		+	+				+
Pseudocodium floridanum	+											
Udotea conglutinata	+											
U. cyathiformis	+											
RHODOPHYCOPHYTA												
Chondria floridana	+											
Fauchea peltata	+	+		+								
PHAEOPHYCOPHYTA												
Dictyota sp.		+										
Sargassum filipendula								+				
S. hystrix	+											
S. polyceratium								+				

Table 7-69. Occurrence of macroalgae in trawl and box core samples from soft bottom stations on the Spring Cruise.

Taxon	Station											
	2	4	5	6	8	12	14	16	20	22	24	28
CHLOROPHYCOPHYTA												
Caulerpa sertularioides					+		+	+		+	+	+
Halimeda discoidea	+	+	+		+			+				+
RHODOPHYCOPHYTA												
Chondria floridana	+											
Fauchea peltata	+	+			+			+				
PHAEOPHYCOPHYTA												
Sargassum filipendula								+				
S. hystrix											+	+
S. polyceratium								+				

Table 7-70. Occurrence of macroalgae in trawl and box core samples from soft bottom stations on the Summer Cruise.

Taxon	Station														
	4	5	6	12	14	16	20	22	24	25	28	31	33	34	37
CHLOROPHYCOPHYTA															
Caulerpa prolifera							+								
C. sertularioides	+	+	+		+	+	+	+		+	+	+			
Halimeda discoidea	+		+			+	+								
Pseudocodium floridanum	+														
Struvea pulcherrima	+		+			+					+				
Udotea conglutinata					+		+			+					
Ulva lactuca		+			+	+					+				
RHODOPHYCOPHYTA															
Chondria floridana			+		+	+	+	+		+					
Fauchea peltata	+	+	+		+	+			+			+			+
Spyridia filamentosa		+					+								
PHAEOPHYCOPHYTA															
Colpomenia sinuosa			+		+				+						
Dictyota spp.			+			+					+				
Padina sp.		+				+			+						
Rosenvingea intricata							+								
Sargassum filipendula		+													
S. hystrix	+	+	+		+	+		+	+	+		+	+	+	+
S. polyceratium			+												

Table 7-71. Occurrence of macroalgae in trawl and box core samples from soft bottom stations on the Winter Cruise.

Taxon	Station														
	4	5	6	12	14	16	20	22	24	25	28	31	33	34	37
CHLOROPHYCOPHYTA															
Anadyomene menziesii											+				
Caulerpa sertularioides	+		+	+	+	+		+		+	+				
Cystodictyon pavonium						+									
Halimeda discoidea	+					+		+			+				
Pseudocodium floridanum	+										+				
Struvea pulcherrima											+				
Ulva lactuca	+														
RHODOPHYCOPHYTA															
Fauchea peltata	+	+	+								+				+
PHAEOPHYCOPHYTA															
Dictyota spp.	+										+				
Padina sp.	+	+													
Sargassum hystrix		+		+			+		+					+	

particular algae between cruises probably reflects problems with sampling methodology (see Section 7.5.3). Stations 16 and 28 exhibited the highest total number of algal taxa--12 over the two-year program); in addition, Stations 2, 4, and 16 supported a relatively high number of algal taxa on at least one cruise. In contrast, Stations 5 and 12 (both at 90m depth) and the deeper (>100m) outer shelf Stations 31, 33, 34, and 37 supported few algal taxa or none. The most ubiquitous macroalgae were the green algae *Caulerpa sertularioides* and *Halimeda discoidea*, and the brown alga *Sargassum hystrix*; the latter was the only macroalga consistently collected at the deep, outer shelf stations. *Halimeda* was generally most commonly collected from mid shelf (40 to 60m depths) stations; high percent cover at several live bottom stations in these depths has been noted in Section 6.0.

Table 7-72 presents the distribution of algal wet weights for all recovered macroalgae for all stations over all cruises. A greater number of algal species (20) was recovered from Year Two samples than for Year One (18). However, a greater biomass was recovered from the Year One samples. *Caulerpa sertularioides* accounted for the greatest portion of the biomass overall (66.1%), followed by *Sargassum filipendula* (20.3%), *Halimeda discoidea* (6.7%), and *Chondria floridana* (1.7%), together accounting for 94.8% of the recovered biomass.

Three taxa identified from the still photographs were not represented in the otter trawl box core samples: *Caulerpa cf. mexicana*, *Cladophora* sp., and *Halymenia*-like Rhodophycophyta. In contrast, many taxa collected in trawl or box core samples were not seen or not identifiable in photographs. Identification of visible algae from the still photographs was very difficult and at times uncertain. Only distinct, easily recognizable forms could be identified with a level of certainty. Furthermore, the uncertain identifications often required verification by the presence of algae within the box core and trawl samples.

Marine angiosperms (flowering plants) were collected from several stations in small amounts. *Thalassia testudinum* (turtle grass) was recovered from Stations 24 and 25 during the Year One cruises. During Year Two, *Thalassia* was recovered from Stations 6, 14, 16, 22, and 25 on the Summer Cruise. *Halophila*

Table 7-72. Distribution of wet weights for all macroalgae collected in otter trawl and box core samples, for all soft bottom stations.

Taxon	YEAR ONE (Fall, Spring) Wet Weight (g)	YEAR ONE (Fall, Spring) Percent of Total	YEAR TWO (Summer, Winter) Wet Weight (g)	YEAR TWO (Summer, Winter) Percent of Total	YEARS ONE & TWO Wet Weight (g)	YEARS ONE & TWO Percent of Total
Anadyomene menziesii	0.0	0.0	<0.1	<0.1	<0.1	<0.1
Caulerpa prolifera	0.0	0.0	<0.1	<0.1	<0.1	<0.1
C. sertularioides	1,738.7	81.6	466.1	38.8	2,204.8	66.1
Chondria floridana	52.5	2.5	3.5	0.3	56.0	1.7
Colpomenia sinuosa	0.0	0.0	0.9	0.1	0.9	<0.1
Cystodictyon pavonium	0.0	0.0	<0.1	<0.1	<0.1	<0.1
Dictyota spp.	9.0	0.4	1.4	0.1	10.4	0.3
Fauchea peltata	18.1	0.8	5.2	0.4	23.3	0.7
Halimeda discoidea	146.4	6.9	78.6	6.5	225.0	6.7
Rosenvingea intricata	0.0	0.0	6.9	0.6	6.9	0.2
Padina spp.	0.0	0.0	1.3	0.1	1.3	<0.1
Pseudocodium floridanum	7.6	0.4	2.5	0.2	10.1	0.3
Sargassum filipendula	10.3	0.5	3.7	0.3	14.0	0.4
S. hystrix	78.0	3.7	598.0	49.7	676.0	20.3
S. natans	40.2	1.9	0.0	0.0	40.2	1.2
S. polycertium	10.0	0.5	<0.1	0.1	10.1	0.3
Spyridia filamentosa	0.0	0.0	1.0	0.1	1.0	<0.1
Struvea pulcherrima	0.0	0.0	19.1	1.6	19.1	0.6
Udotea conglutinata	2.4	0.1	13.1	1.1	15.5	0.5
U. cyathiformis	1.2	<0.1	0.0	0.0	1.2	<0.1
Ulva lactuca	0.0	0.0	0.3	<0.1	0.3	<0.1
Unknown filamentous blue-green algae	0.0	0.0	1.2	0.1	1.2	<0.1
Unknown fragments	17.2	0.8	0.0	0.0	18.0	0.5
TOTALS	2,131.6	100.0	1,202.8	100.0	3,334.4	100.0

baillonis (seagrass) was recovered from Station 14 during the Year One cruises and Stations 14 and 20 for Year Two (Summer Cruise). All seagrass samples were found only as small quantities within the box core samples.

7.5 DISCUSSION

Results of the two-year sampling effort at soft bottom stations on the southwest Florida shelf have produced a broad baseline description of macroinfaunal and macroepibiotal assemblages. The shelf is characterized by a rich, diverse infauna dominated by polychaetes and (to a lesser extent) peracarid crustaceans. The macroepibiota collected in trawls comprise a variety of demersal fishes and crustaceans having different substratum affinities, reflecting, in part, the distribution of scattered live bottom habitat across the otherwise sand-dominated shelf. Shelfwide patterns of infaunal abundance, species richness, diversity, equitability, assemblage composition, and macroepibiotal species richness and assemblage composition were described in the previous section. This section discusses some of these results in the context of other studies of continental shelf benthos and suggests possible environmental influences on soft bottom benthic communities. Section 8.2.2 provides a more formal analysis and discussion of the possible roles of environmental variables in determining the composition of these communities.

7.5.1 Comparisons with Other Studies

7.5.1.1 Infauna

The results of infaunal sampling are in general similar to those observed in other continental shelf environments in the Gulf of Mexico (Dames and Moore, 1979; Flint and Rabalais, 1981), South Atlantic Bight (Frankenberg and Leipper, 1977; Texas Instruments, Inc., 1978a), and the Mid-Atlantic coast (Maurer and Leathem, 1981a,b; Maurer et al., 1982). Most shelf habitats are characterized by a diverse and relatively low-density assemblage of polychaetes and peracarid crustaceans (especially amphipods and cumaceans) that compares to less diverse but more abundant infaunal assemblages in nearshore and estuarine environments (Sanders, 1969; Rex, 1981).

Many of the species, and nearly all of the genera, of common infaunal organisms collected in this study are found in a wide geographic range of shelf environments, though particular species may be associated with particular sediment types and/or bathymetric ranges on any given shelf. The abundant polychaete *Synelmis albini* in our study was also one of the more common infaunal species in the South Atlantic Bight (Texas Instruments, Inc., 1978a; Tenore, unpublished). The spionid *Spiophanes bombyx* is typical of sandy habitats in the South Atlantic Bight (Frankenberg and Leipper, 1977; Texas Instruments, Inc., 1978a), and is also common on the Georges Bank in the North Atlantic (Maurer and Leathem, 1981a), and in shallow sandy habitats on the south Texas outer continental shelf (Flint and Rabalais, 1981). Other widely distributed infaunal genera that were common in our study include *Exogone*, *Aricidea*, *Tharyx*, *Lumbrineris*, and *Prionospio*. The wide geographic range of many infaunal species and genera in contrast to that of epifauna and epiflora reflects, in part, the buffering effect of the sedimentary habitat against environmental variations (especially temperature) in the water column.

Faunal densities observed in this study were in general typical of those previously observed in continental shelf environments and lower than generally observed in estuarine areas. Table 7-73 lists some other results from studies in the eastern Gulf of Mexico for comparison. Similar densities of generally less than 10,000 individuals m^{-2} have been determined in the South Atlantic Bight (Texas Instruments, Inc., 1978a) and the Mid-Atlantic continental shelf (Maurer et al., 1982). With a few exceptions, infaunal density was low at the outer shelf stations, a results in accord with previous findings from the eastern Gulf of Mexico (Dames and Moore, 1979). Also as in the MAFLA results, polychaetes contributed about 60% of the total abundance of infauna.

Species richness in the area was extraordinarily high, about four times that previously reported by Dames and Moore (1979) for the eastern Gulf of Mexico. It is difficult to make broad comparisons here because of between-study differences in area sampled (number of stations) and degree of replication. However, Table 7-73 includes some per-station species richness values for comparison with other results in the eastern Gulf of Mexico.

Table 7-73. Comparison of average species richness (number of species station^{-1}) and faunal density (number of organisms m^{-2}) between the present study and past benthic studies in southwest Florida.

Locality	Depth (m)	Average Species Richness	Average Faunal Density	Source
Hillsborough Bay	1 to 5	29	73,400	Simon, 1978
Mid-Tampa Bay	2 to 8	54	23,160	Mahadevan et al., 1980
Lower Tampa Bay	2 to 5	88	11,061	Mahadevan, 1976
Anclote Sound	1 to 3	90	12,090	Mahadevan and Patton, 1979
Gulf of Mexico (off Anclote to Clearwater)	2 to 15	65	6,513	Mahadevan, 1981
Charlotte Harbor	1 to 2	80	3,170	Texas Instruments, Inc., 1978b
Offshore Charlotte Harbor	20 to 100	59	2,299	Dames and Moore, 1979
Offshore Charlotte Harbor	25 to 90	261*	4,326**	Present Study (Transect A)
Naples Bay	1 to 3	38	6,702	Yokel, 1979
Offshore Naples Bay	25 to 90	285*	7,418**	Present Study (Transect C)
Southwest Florida Shelf	25 to 90	267*	6,633**	Present Study (Transects A-E)

Note: These comparative data should be viewed with caution, because of the different sampling methodologies, sampling frequencies, and number of stations sampled by the investigators; sieve size used in the studies was 0.5mm.

*Data are from individual station tables presented in Section 7.3 and represent average total number of genus or species level taxa collected on all cruises.

**Data are from Table 7-59.

Diversity and equitability values determined in this study are also typical of continental shelf benthos. Nearshore areas, especially those that are organically enriched or polluted, frequently exhibit low diversity because of dominance by a few opportunistic species. Although seasonal and spatial variations in diversity and equitability were evident within our data, none of the stations were dominated by one or a few species.

Infaunal zonation patterns on the shelf appear to represent primarily bathymetric and sediment-type groupings (see Section 8.2.2). Depth- and sediment-related zonation patterns are typical of continental shelf infaunal assemblages (Texas Instruments, Inc., 1978a; Flint and Rabalais, 1981). Comparison of our cluster analysis results with preliminary findings from reanalysis of MAFLA infaunal data (Barry A. Vittor and Associates, Inc., unpublished) suggests very similar depth range groupings of infauna, with many of the same "characteristic" species within particular station groups common to both data sets. The major difference is that MAFLA infaunal transects did not extend far enough south to traverse the Tortugas pink shrimp grounds, where fine carbonate muds predominate. Species typical of this area, including *Sigambra tentaculata*, *Mediomastus californiensis*, and *Paraprionospio pinnata*, were characteristic of muddy sediments in the more northerly MAFLA stations (Barry A. Vittor and Associates, Inc., unpublished).

7.5.1.2 Macroepibiota

Macroepibiota collected in trawls in our study area comprised a variety of fishes, crustaceans, other motile invertebrates, and scattered sessile epibiota. Comparisons of species richness and catch with results of other studies are not warranted due to differences in sampling gear, degree of replication, and area covered, etc. Trawl data from our study can be considered only semiquantitative at best, even with respect to species richness. In addition, the most comparable data, that obtained during the MAFLA surveys, are not currently in a form that is amenable to its use in extensive comparisons. Fish data from our trawls and from MAFLA collections are being analyzed and synthesized by researchers at Texas A&M University (J. Kleypas, Texas A&M University, personal communication).

The macroepibiota included species with both live and soft bottom affinities. The species composition of trawl catches has been used to map the distribution of presumed live bottom on both the South Atlantic Bight (Miller and Richards, 1979) and the west Florida shelf (Darcy and Gutherz, 1984). Our results, which indicate that mid shelf Stations 5, 8, 16, 22, and 28 appear to have the most live bottom character, parallel those of Darcy and Gutherz (1984), who also indicated a predominance of "sponge bottom" at mid shelf depths in our study area. This designation must be used cautiously, because the mapped distribution (e.g., Figure 7-13) does not particularly follow shelfwide trends in the abundance (percent cover) or species richness of sponges (see Section 6.0).

Fish trawling during the MAFLA baseline survey, which covered an area extending from within the Southwest Florida Shelf Study area to the coasts of Mississippi and Alabama, showed some characteristic associations of fish species (Shipp and Bortone, 1979). A sand bottom assemblage typified by *Syacium papillosum* (dusky flounder), *Synodus intermedius* (sand diver), *Centropristis ocyurus* (bank sea bass), and *Sphoeroides dorsalis* (marbled puffer) was widely distributed and characteristic of the entire study area. The most ubiquitously distributed fish species in our collections was *S. papillosum* (both soft and live bottom stations). Similarly, most of the fishes cited by Darcy and Gutherz (1984), as having the highest frequency of occurrence in trawl samples on the west Florida shelf, including *Diplectrum formosum* (sand perch), *Syacium papillosum* (dusky flounder), *Monacanthus hispidus* (planehead filefish), *Lactophyrs quadricornis* (scrawled cowfish), and *Centropristus ocyurus* (bank sea bass), were common in our study.

The trawl cluster analyses indicate predominantly bathymetric station groupings in our study area. Results of investigations in the eastern Gulf of Mexico (Hopkins, 1979; Shipp and Bortone, 1979; Lyons and Camp, 1982) and the South Atlantic Bight (Marine Resources Research Institute, 1982) have revealed similar bathymetric zonation patterns of macroepibiota. Possible environmental influences on these patterns are discussed in Section 8.2.2.

7.5.2 Possible Environmental Influences

Patterns of abundance, diversity, and taxonomic composition of soft bottom benthic communities presumably reflect the influence of a suite of environmental variables that can affect larval settlement, growth, survival, and reproduction of benthic organisms. Variables that are likely to be important determinants of the characteristics of the benthos include temperature, sediment type, light levels, inorganic nutrient levels, and particulate organic matter (POM) inputs.

Infaunal abundance is frequently correlated with the proportion of fine sediments, reflecting overall relationships between sediment grain size and measures of sediment nutritional value (organic carbon and nitrogen content; microbial biomass, etc.) (Longbottom, 1970; Hargrave, 1972). However, these relationships are most likely to apply where there is a source of organic-rich fine sediments (e.g., riverine POM inputs) which are often colonized by opportunistic polychaetes that exhibit rapid population growth (Rhoads and Boyer, 1982). The southwest Florida shelf is basically an oligotrophic environment, with the major POM inputs to the benthos probably deriving from phytoplankton production enhanced by Loop Current-induced upwelling. Fine sediments in the Florida Bay area (inshore end of Transect E) are high in carbonate (inorganic) content and provide an unusual example of a muddy benthic environment that is not characterized by higher than average infaunal abundances. If POM inputs due to Loop Current-induced upwelling or periodic penetration of frontal eddies serve as the major source of food for the benthos, the pattern of shelfwide primary productivity could determine shelfwide abundance patterns for macroinfauna. Similar suggestions have been raised for the benthos of the continental shelf off the South Atlantic Bight (Hanson et al., 1981) and for the Georges Bank area (Maurer and Leathem, 1981b). Hanson et al. (1981) pointed out that many common infaunal species on the continental shelf of the South Atlantic Bight have short generation times and are probably adapted to use irregular pulses of deposited POM. The increased abundance of the orbiniid polychaete *Haploscoloplos* sp. at several mid to outer shelf stations (especially Station 37) in the Winter Cruise results may represent such an opportunistic reponse by at least one species.

The mid shelf maximum in species diversity (infauna) and species richness (infauna and macroepibiota) is an intriguing trend. Although overlapping bathymetric ranges of predominantly nearshore or offshore species may in part account for this, the major faunal break in cluster analyses also occurs at mid shelf depths, so extensive overlapping is not present. For the macroepibiota, we noted that many mid shelf stations exhibited a relatively high proportion of live bottom character, and the presence of mixed habitat types within a "station" contributes to the overall species richness observed. It seems reasonable that habitat heterogenity of substratum at mid shelf stations may also contribute to the high diversity and species richness of infauna collected there.

Zonation patterns of macroinfauna and macroepibiota, as revealed by cluster analyses, appear related to both depth and (especially for infauna) substratum. Depth per se is not an explanatory variable; physiological effects of hydrostatic pressure are generally undetectable at depths of less than 1,000m (Hoar, 1966). The most likely depth-related influences are temperature, POM inputs, light, nutrients, and frequency of sediment disturbance. The possible roles of these and other regulatory environmental variables are discussed further in Section 8.2.

7.5.3 Methodology Evaluation

Inherent in any survey of the marine benthos are methodological limitations. Particularly when attempting to quantitatively sample the soft bottom benthos for macroinfauna, the following items must be considered:

- Reliability and accuracy of the sampling device (consistent substrate penetration, no sample loss upon retrieval, etc.). Characteristics for a good sampling device are described by Menzies and Rowe (1968) and Holme and McIntyre (1971).

- Adequate sieve size to retain a majority of the macrofauna (Reish, 1959).

- Sufficient replication to: 1) describe within-station faunal variation, and 2) obtain a majority of the species inhabiting the site.

- Sufficient temporal frequency of sampling to address seasonal variations in fauna.

- Reliable procedures for narcotization, preservation, and storage of samples.

7.5.3.1 Sampling Gear

For this study two types of gear were used to sample the soft bottom benthos: 1) a modified Reineck box core sampler (19cm x 30cm x 40cm deep) (Bouma and Marshall, 1964; Farris and Crezee, 1976); and 2) a Marinovich 7.6m semiballoon otter trawl with 3.8cm stretch mesh in the body of the net, and 1.3cm mesh in the cod end.

The modified Reineck box core sampler has proved to be a reliable remote sampling device. It consistently penetrates most types of soft substratum to at least 30cm and has a spade arm which penetrates the sediment and seals off the bottom of the core to prevent wash out upon retrieval. Two problems were occasionally manifest with this box core sampler, however. In dense compacted sands, it was sometimes difficult for the spade to close off the core, resulting in a bent spade arm or an incompletely closed core. The second problem was incomplete closure of the box core due to large sediment particles interfering with the seal, which occasionally resulted in a "wash out." These problems were resolved by: 1) adjusting the weights on the core to give a shallower penetration into sand, thus allowing the spade to penetrate the substratum; and 2) accepting for analysis only those cores that did not exhibit wash out.

In order to determine if the depth of penetration (30cm) of the box core was sufficient to collect the majority of the macroinfauna (species and numbers), cores from two stations (4 and 12) from the Spring Cruise were stratified into upper and lower 15cm sections and processed separately. Details of the analysis are presented in the Year One report. Briefly, the upper 15cm sediment fractions contained 95% of the total taxa found at both Stations 4 and 12. Most of the individuals collected were also from the upper portion: 94% at Station 4, and 96% at Station 12. The relative proportions of taxa and number of individuals for upper vs. lower portions varied only slightly between polychaete and non-polychaete faunal groups. For both stations, processing of the 15 to 30cm fraction did not add a significant amount of additional information. Therefore, it is believed that for the study area a 15cm core penetration is sufficient to characterize the benthic macroinfaunal community. This finding agrees with the general consensus in the literature concerning infaunal distributions, but it should be noted that this is not always the case. Christie (1976) and Christie and Cutler (1974) have found large proportions of species within an area to penetrate below 30cm. The extent to which fauna penetrate the substratum depends on a variety of factors. These can include sediment texture; presence of obstacles within the sediment (Masse, 1970); oxygen permeability of sediments and species tolerance of oxygen deficiency; species burrowing ability and the presence of burrows utilized by non-burrowing species; interspecific competition; and ability of a species to feed below the sediment surface (Christie, 1976).

Another inherent drawback of coring devices is their inability to quantitatively sample motile epifauna or sparse sessile epibiota. Many epifaunal organisms are known to actively avoid entrapment by sampling gear (Gunter, 1957; Roessler, 1965).

7.5.3.2 Sieve Size

The sieve size used to remove macrofauna from the sediments in this study was 0.5mm. This was the mesh shown by Reish (1959) to be most effective in removing the majority of the infaunal species and individuals from the sediments. Because the use of a larger sieve mesh (e.g., 1.0mm) would reduce the amount of sediment to be processed and therefore reduce the labor involved in rough sorting samples, a comparison of the effectiveness of 1.0 and 5.0mm sieves was conducted. Two stations (6 and 8) were processed using both a 1.0 and a 0.5mm sieves for the Spring Cruise. Details of the results are presented in the Year

One report. Results were consistent between stations. Slightly more than half (62% at Station 6; 57% at Station 8) of the enumerated taxa were retained on the 1.0mm sieve. However, the majority of individuals were retained by the 0.5mm sieve (81% at Station 6; 82% at Station 8). As a result of this test, it was concluded that a 1.0mm sieve would be inadequate to properly enumerate and characterize the benthic infaunal community. A 0.5mm mesh sieve was, therefore, used throughout this study.

7.5.3.3 Replication

Box Cores -- There are no generally agreed-upon standards of sampling adequacy for the marine benthos. The species-area criterion has been discussed by various authors (Gleason, 1922; Holme, 1953; Ursin, 1960; Williams, 1964; Holme and McIntyre, 1971), but a universal standard of "saturation" has not been established. The number of samples required to adequately sample an area depends on the variability of the individual observations, which in turn depends on the size or scale of the individual station and the scale of patchiness within it. A "large" station would require a greater number of samples than a "small" station, presumably because the "large" station would encompass a greater number of habitats and therefore a greater number of species.

For this study five benthic box cores were taken at each station. Taxa-saturation curves were constructed as a means of evaluating replication adequacy, and some examples are presented in Figure 7-22. Because of the random method of obtaining bottom grab samples (i.e., remotely deployed), there is no real need for additional randomization of replicates for determination of taxa-saturation curves. However, due to random variability, certain combinations of replicate order will change the configuration of the curves. Therefore, each plotted curve (Figure 7-22) is the mean of all possible replicate combinations, or the "ideal" curve. If the percentage increase in number of species between the fourth and fifth replicates were less than 10% of the total species found for all five replicates, then replication was considered adequate. This definition, although arbitrary, has been found to be useful by the authors for other studies and offers a definitive criterion for acceptance or rejection of replication levels. Of 60 discrete station samplings, 14 (23%) were found to

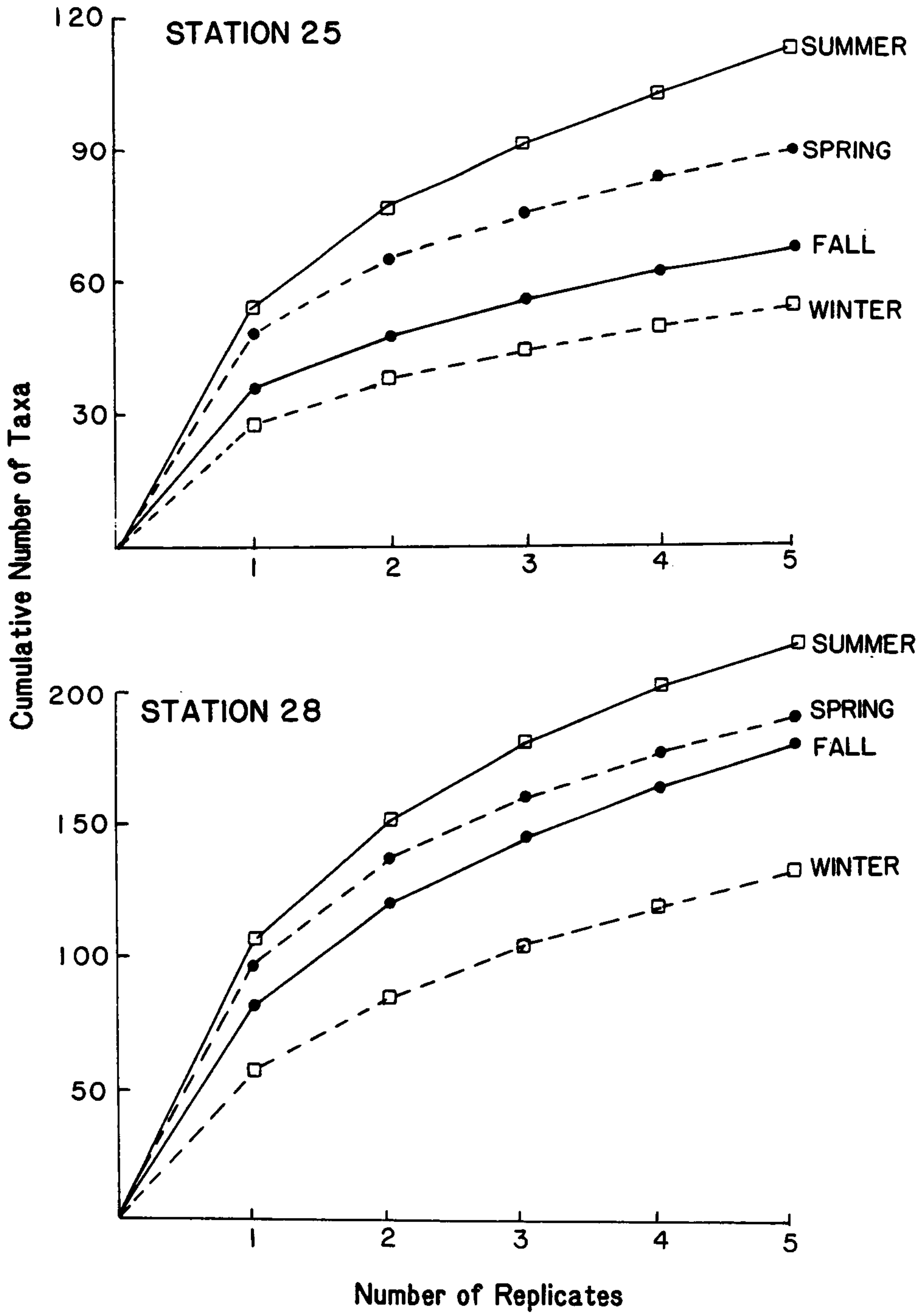


Figure 7-22. Taxa-saturation curves for box core infauna at Station 25 and 28.

satisfy the 10% saturation criterion, representing 12 of 19 stations. Thus, 63% of the stations sampled exhibited inadequate taxa-saturation for one or more cruises. Variation of saturation levels did not seem to be a seasonal phenomenon (i.e., there were no trends on a cruise basis of overall mean percentage increases between fourth and fifth replicates).

Another view of replication adequacy is obtained by calculating the percentage of taxa that (on the average) are unique to that core, and examining the variation in this percentage in relation to the number of replicate cores. Figure 7-23 shows examples for three discrete station/season samples that exhibited a wide range in the number of taxa collected. At Station 28 (Summer Cruise) and Station 25 (Winter Cruise), 15% to 20% of the taxa collected in any particular "fifth" core were likely to be unique to that core; the percentage was about twice as high for Station 37 (Winter Cruise). Increasing the number of replicate samples would result in the collection and processing of more individuals and taxa but a progressively smaller percentage of new information.

The problem of inadequate species saturation may be related to: 1) too few samples taken at these stations; or 2) station sizes were too large and therefore multiple habitat types were being sampled within a station. Because the cores were deployed from a ship that was not at anchor (ship's position was maintained as close as possible to a fixed buoy), the second alternative as well as the first is quite feasible. Habitat patch sizes are known to be quite variable for the west Florida continental shelf (Gould and Stewart, 1955; Doyle and Sparks, 1980; Culter and Mahadevan, in prep.). It was believed by the authors that the overall sampling effort yielded good results in spite of samples not meeting the arbitrary 10% saturation criterion. Additional replicates would have been valuable, especially for the borderline saturation cases. However, in large-scale baseline surveys, there is usually a trade-off between adequacy at particular stations and extensiveness of coverage. Future intensive studies in the area will clearly require a greater degree of replication. Determination of patch size in relation to sampling methodologies was beyond the scope of this study.

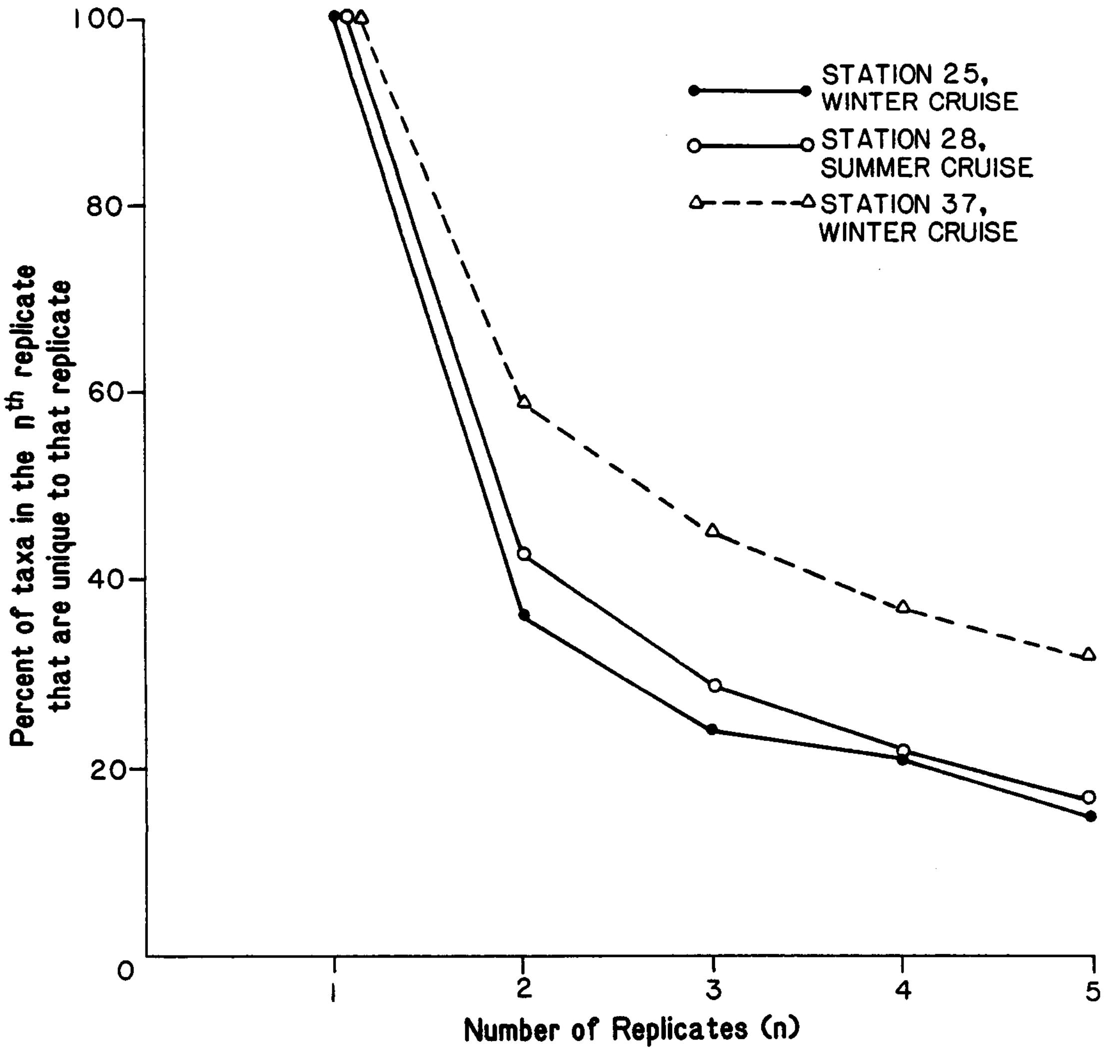


Figure 7-23. Decline in new information (represented by the percent uniqueness of taxa in a given replicate) with successively higher numbers of replicate infaunal box core samples. See text for explanation.

Otter Trawls -- Trawls are qualitative sampling devices (Gunter, 1957; Holme and McIntyre, 1971). To obtain quantitative information from a trawl, a measuring device must be attached to the gear to record the distance travelled over the bottom (Gunter, 1957). If the bottom distance is accurately known, then the entire catch can be sorted and identified, which would quantify the sample. Trawls not so equipped are at best semi-quantitative. Sorting only subsamples of the catch introduces additional error of unknown magnitude by deleting the rarer species. Furthermore, trawls of long duration are likely to cross a variety of habitats, resulting in a mixed assemblage of organisms. Reasonable estimates of benthic epibiota can be obtained provided trawling speeds are relatively slow and constant and of short enough duration to prevent clogging of the net. Numerous short tows have been found to be more effective in obtaining species saturation than singular long tows (Livingston, 1976).

It would not be valid to quantify the soft bottom trawl samples taken for this study. Trawling duration was generally comparable between stations and sampling periods (Table 7-74,) but only a small portion (subsample) of the catch was retained for identification. Only occasionally was an entire trawl catch saved. It is also known that night trawls are more effective in capturing both larger numbers and a greater diversity of species than daylight trawls (Livingston, 1976). Specific sampling times (day vs. night) for a given technique were generally arbitrary and depended solely upon when the ship was "on station." Table 7-75 (species richness) indicates the relative sampling time (day vs. night) for each station. For three of the four cruises, the night trawls exhibited a greater species catch than day trawls, but the difference was not significant (based on F-test) (Steel and Torrie, 1960). The night trawls were also generally of a shorter duration (Table 7-74) than the day trawls. The manner of collection (i.e., one trawl per station, variable tow lengths) did not lend itself to reliable statistical analyses. Because of these factors, all quantitative analyses and comparisons should be interpreted with caution and used only for distinguishing general trends.

Table 7-74. Otter trawl duration (minutes on bottom) for all soft bottom stations.

Station	Cruise				Mean
	Fall	Spring	Summer	Winter	
2	11 ●	13 o	-	-	20.0
4	17 ●	10 ●	14 ●	17 o	14.5
5	16 o	10 o	12 ●	22 ●	15.0
6	17 ●	10 ●	12 ●	15 ●	13.5
8	10 ●	10 ●	-	-	10.0
12	11 ●	10 o	13 ●	16 ●	12.5
14	16 o	9 o	8 ●	8 o	10.3
16	18 o	9 ●	7 ●	15 ●	12.3
18	7 ●	10 ●	-	-	8.5
20	12 ●	11 o	16 o	10 ●	12.3
22	11 ●	10 ●	14 ●	12 o	11.8
24	7 o	12 ●	16 ●	20 ●	13.8
25	13 o	30 o	14 o	10 ●	16.8
26	14 ●	20 ●	-	-	17.0
28	11 ●	20 o	17 o	7 o	13.8
31	-	-	15 ●	16 ●	14.3
33	-	-	20 ●	18 o	19.0
34	-	-	21 o	19 ●	20.0
37	-	-	20 o	20 o	20.0
Mean (All)	12.7	12.9	14.6	15.0	
Mean (Night)	12.1	11.4	13.1	15.6	
Mean (Day)	14.0	14.7	17.6	13.7	

● = Night sample; o = Day sample

7.5.3.4 Temporal Sampling Frequency

The variation in faunal composition between cruises has been examined above and attributed to "seasonality." Generally, deep-sea benthic communities exhibit less variation than continental shelf areas, which in turn exhibit less variation than the nearshore and estuarine zones (Tait and DeSanto, 1972). While the individual stations often showed substantial amounts of faunal variation between cruises (indicating seasonality), the analyses usually indicated strong similarities for same-station comparisons, regardless of the cruise (season). Strong seasonal trends in faunal composition have been revealed by investigators for nearby coastal areas (Saloman, 1974; Simon, 1974; Dauer and Simon, 1975; Mahadevan et al., 1977; Conner and Simon, 1979; Mahadevan, 1981).

In this study, samples were collected during all four seasons but over a period of about 16 months. Although it would be useful to sample all four seasons during a single year or to repeat seasonal sampling to determine whether any apparent "seasonal" trends are consistently observed, the temporal spacing of cruises during the present study appeared sufficient to detect plausible seasonal trends.

7.5.3.5 Processing Procedures

Procedures used for narcotization (magnesium sulfate solution) (Russell, 1963) preservation (formaldehyde) (Russell, 1963; Holme and McIntyre, 1971) staining (Rose Bengal) (Mason and Yevich, 1967; Korinkova and Sigmund, 1968; Hamilton, 1969; Williams and Williams, 1974) and storage (isopropyl alcohol) (Russell, 1963; Holme and McIntyre, 1971) are well documented. Details of the procedures used were presented in the Year One report.

7.5.4 Need for Further Study

Further studies of soft bottom benthos on the southwest Florida shelf should focus on dynamic aspects of the shelf ecosystem, and benthic processes. Important variables to be measured include:

Table 7-75. Species richness (number of taxa identified to genus or species) for otter trawl samples for soft bottom benthic stations.

Station	Cruise				Mean	Station Rank
	Fall	Spring	Summer	Winter		
2	22 ●	15 o	-	-	18.5	18
4	37 ●	39 ●	55 ●	64 o	48.8	7
5	76 o	44 o	70 ●	71 ●	65.3	3
6	53 ●	25 ●	30 ●	52 ●	40.0	11
8	67 ●	87 ●	-	-	77.0	2
12	56 ●	26 o	40 ●	66 ●	47.0	8
14	40 o	24 o	19 ●	19 o	25.5	17
16	73 o	100 ●	90 ●	99 ●	90.5	1
18	43 ●	27 ●	-	-	35.0	12
20	15 ●	24 o	28 o	40 ●	26.8	14
22	70 ●	56 ●	26 ●	79 o	57.8	5
24	41 o	47 ●	56 ●	73 ●	54.3	6
25	33 o	24 o	31 o	10 ●	24.5	16
26	42 ●	44 ●	-	-	43.0	9
28	88 ●	59 o	54 o	45 o	61.5	4
31	-	-	23 ●	43 ●	33.0	13
33	-	-	32 ●	48 o	40.0	11
34	-	-	48 o	33 ●	40.5	10
37	-	-	24 o	28 o	26.0	15
Mean (All)	50.4	42.7	41.7	51.1		
Mean (Night)	49.3	53.1	44.1	54.1		
Mean (Day)	52.6	30.9	37.0	47.2		

● = Night sample; o = Day sample

1) The rate of POM deposition to the benthos in different areas of the shelf;

2) The composition (carbon and nitrogen content, etc.) of sedimenting POM;

3) Standing crop of benthic microalgae at different locations, and rates of benthic microalgal production (important for surface deposit feeders and microphagous herbivores);

4) Frequency and severity of sediment disturbance (e.g., by storms); and

5) Rates of recolonization of defaunated sediment by infaunal organisms.

All of these can be determined using presently available field techniques. Measurements of sediment deposition rates and frequency of sediment disturbance are currently being conducted during Years Four and Five of the ongoing Southwest Florida Shelf Study series (R. Avent, 1985, personal communication, Minerals Management Service).

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.