D

EPIFAUNAL AND EPIFLORAL BENTHIC COMMUNITIES IN THE MAFLA YEAR 02 LEASE AREA

University of Alabama, Marine Science Program

Principal. Investigator:
Thomas S. Hopkins

Associate Investigator:
GRUNT Laboratory Staff

INTRODUCTION

The following summary report is in partial fulfillment of Contract 08550-CT5-30 between the State University System of Florida and the Bureau of Land Management, Department of the Interior. As a result of a subcontract with the State University System of Florida, this investigator and his associates undertook the responsibility for those portions of the Contract dealing with the Benthic Sampling and subsequent analyses as defined by (1.) epifaunal and epifloral elements (exclusive of demersal fishes) of Trawl and Dredge and (2) the epifloral and epifaunal elements of Diving. This responsibility also included collection, preparation and delivery of samples for chemical and histopathological analysis.

In addition to the above, this investigator and his associates assumed responsibility for the total benthic sampling program in the Rig Monitoring effort.

As a result of these activities, this principal investigator performed 154 days of Chief Scientist's duties aboard ship during this Contract. These days are exclusive of report writing, meetings attended, or time spent in laboratory analyses.

METHODS

A. Field

1. Diving - The mode of collection during diving operations was principally by hand although nets, bags, trawls, and scoops were used with a variety of estimates of success. Photography was accomplished with hand held 35 mm Nikonos II cameras using close-up, 28 mm and 35 mm lenses and Sub Sea Mk 150 strobes for illuminations. In addition, Super 8 movies were taken

with a Nikon Super 8 Camera or a Kodak XL 55 Super 8 Camera in a pressure resistant housing outfitted with dual 100 w cinema lights. Only color film was used.

Quantitative measures involving individuals per area were done by two methods as appropriate to the task.

(a) The $5 m^2$ System - At "each of the Florida Middle Ground (FMG) stations, a 5 m x 50 m strip transect was deployed. The strip transect was further segmented into 5 m subunits by attaching cross lines at 5 m intervals along the 50 m line thus producing 10 $5\text{-}m^2$ quadrats. As a point of reference, Quadrat one was always the deepest quadrat with Quadrat ten intended to be the shallowest inasmuch as the strip transect was intended to lay in consort with a deep to shallow axis. (We were not totally successful with this objective during all sampling efforts,)

This system was used to delineate "Community Structure" at the dive site, and for quantitative studies of Scleractinia and Octocorallia.

(b) The $0.25 m^2$ System - At each of the FMG stations and at Clearwater (CW) too, we employed a $0.25 m^2$ grid (inside area) to count and measure suitable biota e.g. algae. This grid was deployed in the study area for both random and biased collections for algal species diversity and biomass.

2. Dredge/Trawl - Dredging was accomplished through the use of a Capetown Dredge with removeable/interchangeable basket. Trawling was accomplished with a $?.1 m semi-balloon trawl..

3. Shi.p-beard Photography - On board photography was accomplished through a Testrite Copy Stand fitted with a Nikon F2S SLR Camera Macro lens; this work was also accomplished with a Canon FTQL with a natural light,.

P

B

A. Laboratory

1. Microscopy - Faunal identifications were taken to "best available" level through the use of a Wild N-20 binocular compound phase microscope, a Wild M-5 binocular dissecting microscope, or a Nikon binocular dissecting microscope depending on material examined and microscope available. The Nikon microscope was found to be decidedly inadequate for most all work beyond the family level. (It is furnished with a poorly designed/constructed illumination system, and its optics are incapable of resolving structural detail at its listed higher magnification.) It should be noted that although these Nikon microscopes were not purchased by BLM they were used because a BLM representative specifically stated during contract negotiations that he thought this brand microscope should be adequate for the level of results they sought. I disagreed, and I was not allowed to purchase the number of correct microscopes I thought necessary for the project.

2. Numerical Analysis

(a) Faunal Similarity - In order to determine faunal similarities between samples (= station locations) the "index of similarity" (S) used by Bray and Curtis (1957) has been used:

$$S = \frac{2C}{A + B}$$

where:

A = number of species in Sample A
B = number of species in Sample B
C = number of species common to both samples

the results of which are plotted by way of a matrix with stations or transects linearly arranged. A "Sanders type" (Sanders, 1960) "trellis diagram" can be adopted by arranging the stations so that samples with highest values are brought into closer proximity.

Species diversity of selected biota will be based on the Shannon measure of diversity (Pielou, 1966) where:

$$H = -\Sigma p_i \ln p_i.$$

in which pi represents the proportion of the i-th species. In order to measure the eveness with which individuals are divided among species found, Pielou's (Pielou, op. cit.) measure of eveness will be used:

$$J' = H'/H'_{max}$$

in which $H'_{max} = \log s$ and s= number of species present.

MATERIALS

In accordance with II.B.2.a.i. (b) of Contract 08550-CT5-30. Dredge/Trawl samples were fine sorted into Molluscs, Arthropods, Echinoderms, Polychaetes, and "miscellaneous". Identifications were to be carried out to the family level and to genus and species for polychaetes and molluscs where possible. Algae and sea grass were to be carried to species level. Biomass determinations were not required. In case of diver collected samples allorganisms were to be identified to species level. Labeling and archiving was required of all materials collected.

The effort described in this final report surpasses that required by the Contract. We have dealt with the below listed groups with explanatory notations and limitations as follows.

1.) Molluscs

Dredge/Trawl - We have carried most all molluscs to beyond the family.

Diving - Same as above; mostly to species.

2) Arthropods

Dredge/Trawl - Amongst the arthropod macrofauna we were able to sort out Decapod Crustaceans, Stomatopod Crustaceans, and Pycnogonids. These have been carried well beyond the family level and most are to species rank.

Diving - Same as above; mostly to species.

3) Echinoderms

Dredge/Trawl - All echinoderms are carried to at least the family rank; depending on literature which is difficult to come by, the majority are carried beyond the family rank.

Diving - All echinoderms are carried to specific rank with the exception of a few possible new species.

4) Polychaetes

Dredge/Trawl - All polychaetes are carried to at least the family rank; the majority are carried beyond the family.

Diving - Same as above.

5) Miscellaneous

a) Octocorallia and Scleractinia

Dredge/Trawl - All material carried to at least family rank; the majority beyond family, dependent on literature.

Diving - All material to species rank.

b) Poriferans (Sponges) - A general statement must be made with regard to all "sponge" material: We have found that the field 0-r systematics in sponges is fraught with uncertainties even above the family level. We have sought and received help from three qualified workers in the field. We are still very much in the dark on much of our material, but we are reporting at levels that we feel are equivalent to the "state of the field".

c) Reef Fish Observations

Diving - We provide these data,although not required, in the interest of community characterization and good science.

6) Algae

Dredge/Trawl - All algae are carried at least to generic rank.

Diving - All algae are carried to the specific rank where possible.

RESULTS

Results of the benthic macro-epifaunal/epifloral study through dredging, trawling, and diving can be summarized by groups as follows:

I. Molluscs

A. Number of species recorded overall - 236

1. Total through Dredge/Trawl - 189

a. Transect I - 70
b. Transect II - 57
c. Transect 111 - 68
d. Transect IV - 60
e. Transect V - 59
f. Transect VI - 70

2. Total through Diving - 105

a. Florida Middle Ground (FMG) - 70
b. Clearwater (CW) - 57

B. Prospective "New" species

Dendrodoris sp. (from II A, and VI B); specimens are now being examined by a specialist.

C. New Distribution Records

1. Dredge/Trawl

   a. Platydoris angustipes
   b. Anisodoris prea
   c. Peltodoris greeleyi
   d. Malluvium benthophilum
   e. Dentalium taphrium
   f. Dentalium floridense
   g. Dentalium laqueatum

2. Diving

   a. Coralliophila abbreviata
   b. Antillophos adelus
   c. Crassispira cubana
   d. Piss.ni% tincta
   e. Muricopsis oxytatus

In addition we have forty-six possible additional new records. These additional. new records a-wait verification.

D. Predominant species at each station.

1. Dredge/Trawl

IA	Chlamys benedicti, Aequipecten muscosus, Hiatella arctic
IB	Chlamys benedicti, Turritella exoleta, Xenophora conchyliophora
IC	Murex beauii, Murex hidalgo, Tugurium caribeaum
IIA	Aequipecten muscosus, Hiatella arctica, Calliostoma pulchrum
IIB	Chlamys benedicti, Chama congregata, Antillophos candei
IIC	Murex beauii, Tugurium caribeaum, Ant i 1 lophos candei
111A	Chlamys benedicti, Lima pellucida, Spondylus americanus
IIIB	Pteria colymbus, Lima pellucida, Barbatia domingensis
IIIC	Murex beauii , Tugurium caribeaum, Aequipecten glyptus
IVA	Chlamys benedicti, Aequipecten muscosus, Argopecton gibbus
IVB	Oliva sayana, Mercenaria campechiensis, Argopecton gibbus
IVC	Murex beaui i , Tugurium caribeaum, Polystira tellea
VA	Pecten raveneli, Turritella exoleta, Argopecton gibbus
VB	Turritella exoleta, Mercenaris campechiensis, Barbatis domingensis
VC	Aequipecten glyptus, Nuculana acuta, Polystira tellea
VIA	Distorsio clathrata, Murex fulvescens, Jouannetia quillingi
VIB	Turritella exoleta, Malluvium benthophilium, Barbatia domingensis
VIC	Murex beauii , Antillophos candei , Fusinus eucosmius

2. Diving

FMG 047, 147, 151, 247, 251
Spondylus americanus, Cerithium litteratum, Pteria colymbus
146
Spondylus americanu s, Cerithium litteratum, Hiatella arctica

CW

062 - Aequipecten muscosus, Calliostoma pulchrum, Hiatella arcti ca

064 - Aequipecten muscosus, Calliostoma pulchrum, Crepidula plana

ARTHROPODS

11. Decapod Crustacea

A. Number of Species Recorded Overall - ~190

1. Dredge/Trawl by Transect Total. 134

a. Transect I - 76
b. Transect II - 51
c. Transect III - 66
d. Transect IV - 47
e. Transect V - 59
f. Transect VI - 63

2. Diving by Area Total 74

a. Florida Middle Ground (FMG) - 55
b. Clearwater (CW) - 35

B. Prospective "New" Species

1. Dredge/Trawl

a. Periclimenaeus n. sp. (from IA, IIIA)
b. Alpheus n. sp. I (from IIC, IIIB, IIIC)

2. Diving

a. Perıcliminaeus n. sp. (from 151)
b. Synalpheus n. sp.I(from 147, 151, 146, 247, 047)
c. Synalpheus n. sp. II (from 047, 251, 151, 147)

C. New Distribution Records

1. Dredge/Trawl

a. Gulf of Mexico

Alpheus n. sp. I (near A. macrocheles)
Periclimenaeus n. sp.

b. Eastern Gulf

Periclimenaeus caraibicus
Lysmata intermedia
Lysmata rathbunae
Alpheopsis labis
Lipkebe holthuisi
Upogebia operculata

2. Diving

a. Gulf of Mexico

Synalpheus brevifrons
Synalpheus n. sp. I (near S. rathbunae)
Synalpheus n. sp. II (near S. townsendi)
Trachycaris restricts
Alpheopsis labis
Periclimenaeus bredini

b. Eastern Gulf

Gnathophyllum modestum
Pontonia margarita
Periclimenaeus perryae
Periclimenaeus ascidiarum
Periclimenaeus perlatus
Periclimenes iridescent
Lysmata rathbunae

D. Predominant Species at Each Station

1. Dredge/Trawl

IA Portunus spinicarpus, Stenocionops furcata coelata, Stenorynchus seticornis
IB Dormidia antillensis, Portunus spinicarpus, Parthenope agona
IC Pylopagurus discoidalis, Pyromaia arachna, Palicus sica
IIA Calappa flammea, Sicyonia brevirostris, Penaeus duorarum
IIB Dardanus insignis, Iliacantha subglobosa, Anasimus latus
IIC Myropsis quinquespinosa, Acanthocarpus alexandri, Goneplax hirsuta
IIIA Mithrax acuticornis, Stenorynchus seticornis, Portunus spinicarpus
IIIB Portunus spinicarpus, Podochela gracilipes, Palicus sica

IIIC Goneplax hirusta, Acantho carpus alexandri, Portunus spini carpus
IVA Ranilia muricata, Osaclita semitovis, Stenocionops furcata coelata
IVB Portunus spinicarpus, Anasimus latus, Sicyonia brevirostris
IVC Acanthocarpus alexandri, Goneplax hirusta, Myropsis quinquespinosa
VA Parthenope fraterculus, Collodes trispinosus, Portunus spini carpus
VB Anasimus latus, Osachila semilevis, Sicyonia brevirostris
VC Pyromaia arachna, Ethusa microphthalma, Myropsis quinquespinosa
VIA Portunus spinicarpus, Sicy oni a brevi rostris, Dri dopagurus dispar
VIB Stenorynchus seticornis, Anasimus latus, Podochela sp.
VIC Pyromaia arachna, Ethusa microphthalma, Dardanus insignis

2. Diving

FMG 047, 147, 251, 151, 247, 146
Stenorynchus seticornis, Synalpheus townsendi, Mithrax acuticornis
CW 062
Stenorynchus seticornis, Mithrax pleuracanthus, Lobopilumnus agassizii

III. Echinoderms

A. Number of spec ies recorded overall - 65+

1. Total through Dredge/Trawl - 61

a. Transect I - 32
b. Transect II - 17
c. Transect III - 38
d. Transect IV - 20
e. Transect V - 18
f. Transect VI - 28

2. Total through Diving - 20

a. Florida Middle Ground (FMG) - 18
h. Clearwater (CW) - 6

B. l'respective "New" Species

Ophiact is sp. (from all FMG stations)

C. New Distribution Records

1. Dredge/1'rmwl

a. Gulf of' Mexico

None verified as yet

2. Diving

a. Gulf of Mexico

Prospective new species (above)

D. Predominant Species at Each Station (maximum of three(3))

1. Dredge/Trawl

IA	Luidia clathrata, Ophiothrix angulata, Lytechinus variegatus
IB	Comactinia meridionalis, Anthenoides piercei, Astroporpa annul ata
IC	Astropecten cingulatus, Araeosoma violaceum, Brissopsis elongata
11A	Luidia clathrata, Lytechinus variegatus, Arbacis punctulata
IIB	Astroporpa annulata, Clypeaster ravenelli
IIC	No truly dominant form established
111A	Goniaster tesselatus, Ophiolepis elegans, Eucidaris tribuloides
IIIB	Luidia elegans, Astroporpa annulata, Clypeaster ravenelli
IIIC	No truly dominant form established
IVA	Luidia clathrata Ophiolepis elegons, Lytechinus variegates
IVB	Anthenoides piercei, Clypeaster ravenelli
IVC	No truly dominant form established
VA	Luidia clathrata, Ophiolepis elegans, Eucidaris trjbul.tides
VB	Astroporpa annulata, Clypeaster ravenelli, Schizaster orbignyaqus
VC	No truly dominant form established
VIA	Luida clathrata, Ophiolepis elegans, Clypeaster durandi
VIB	Anthenoides piercei, Astroporpa annulata, Stylocidaris affi nis
VIC	Luidia elegans, Clypeaster ravenelli, Coelopleurus floridanu:

2. Diving

FMG 047, 146, 147, 151, 251

Coscinasterias tenuispina, Ophiothrix angulata, Diadema antillarum

247

Coscinasterias tenuispina, Ophiothrix angulata, Arbacia punctulata

CW 062
Arbacia punctulata, *Lytechinus variegatus*, *Ophiothrix angulata*
064
Arbacia punctulata, *Lytechinus variegatus*

COELENTERATES (Octocorallia/Scleractinia)

IV. Octocorallia

A. Number of Species Recorded - 25

1. Total. through Dredge/Trawl - 19

a. Transect I - 3
b. Transect 11 - 8
c. Transect III - 15
d. Transect IV - 8
e. Transect V - 1
f. Transect VI - 8

2. Total through Diving -

a. Florida Middle Ground (FMG) - 13
b. Clearwater (CW) - 1

B. Prospective "New" Species

None at this time

C. New Distribution Records

1. Dredge/Trawl

a. *Bebryce parastellata*
b. *Bebryce grandis*
c. *Nidalia occidentalis*
d. *Villogorgia nigrescens*
e. *Neospongodes agassizi*
f. *Scleracis quadaloupensis*

2. Diving

a. *Lophogorgia cardinals*
b. *Diodogorgia nodulifera*
c. *Pterogorgia quadalupensis*
d. *Pseudopterogorgia rigidia*

D. Predominant Species at Each Station

1. Dredge/Trawl

IA *Diodogorgia nodulifera*, *Bebryce parastellata*, *Ellisella barbadensis*
IB *Bebryce parastellata*
Ic No truly dominant form established
11A *Diodogorgia nodulifera*, *Bebryce grandis*
IIB *Bebryce parastellata*, *Neospongodes agassizii*
IIC *Bebryce grandis*
111A *Bebryce parastellata*, *Villogorgia nigrescens*, *Muricea elongata*
IIIB *Bebryce parastellata*, *Bebryce grandis*, *Paramuricea* sp. *A*
IIIC *Bebryce parastellata*, *Villogorgia nigrescens*
IVA *Bebryce parastellata*, *Bebryce grandis*, *Ellisella elongata*
IVB *Bebryce parastellata*, *Bebryce grandis*, *Nidalia occidontalis*
IVC *Ellisella barbadensis*
VA *Bebryce parastellata*
VB *Bebryce parastellata*
Vc No truly dominant formestablished
VIA *Bebryce parastellata*, *Scleracis guadalupensis*, *Ellisella barbadensis*
VIB *Bebryce parastellata*, *Bebryce grandis*, *Villogorgia nigrescens*

2. Diving

FMG - all stations
Muricea laxa, *M. elongata*, *Eunicea calvculata*
CW - all stations
Diodogorgia nodulifera

V. Scleractinia

A. Number of Species Recorded - 30

1. Total through Dredge/Trawl - 21

a. Transect I - 5
b. Transect 11 - 9
c. Transect III - 4
d. Transect 1?' - 2
e. Transect V - 5
f. Transect VI - 7

2. Total through Divine - 17

a. Florida Middle Ground (FMG) - 1
b. Clearwater (CW) - 8

B. Prospective "New" Species

Caryophyllia horologium n. sp.
Flabellum fragile n. sp.

C. New Distribution Records

1. Dredge/Trawl

a. Cladocora debilis
b. Solenastrea byades
c. Paracyathus defilippi
d. Oculina tenella

2. Diving

a. Manicina arelolata
b. Scolymia lacera
c. Dichocoenia stokesii
d. Meandrina meandites
e. Cladocora arbuscula

D. Predominant Species at Each Station

1. Dredge/Trawl

IA	Cladocora arbuscula, Oculina diffusa, Oculina tenella
IB	Caryophyllia horologium
IC	Paracyathus pulchellus, Trochocyathus rawsoni , Caryophyllia berteriana
IIA	Phyllangia americana, Oculina diffusa, Stephanocoenia michelini
IIB	Cladocora arbuscula, Paracyathus pulchellus , Caryophyllia horologium
IIC	Balanophyllia floridana, Flabellum fragile, Caryophyllia berteriana
IIIA	Madracis decactis
IIIB	Paracyathus pulchellus
IIIC	Paracyathus pulchellus, Balanophyllia floridana
IVA	Oculina tenella
IVB	Paracyathus pulchellus, Balanophyllia floridana
IVC	Nothing recorded
VA	Cladocora debilis
VB	Madracis asperula, Balanophyllia floridana
Vc	Paracyathus pulchellus
VIA	Madrepora carolina, Oculina diffusa
VIB	Paracyathus pulchellus, Madrepora carolina
VIC	Paracyathus pulchellus

2. Diving

FMG - all stations
Madracis decactis, *Porites diva ricata*, *Dichocoenia stellaris*
CW - all stations
Solenastrea hya des, *Cladocora arbuscula*, *Phyllangis americana*

VI. Polychaete Annelids

A. Number of Species Recorded Overall - 100+

1. Total through Dredge/Trawl - 97

a. Transect I - 31
b. Transect II - 14
c. Transect III - 46
d. Transect IV - 34
e. Transect V - 47
f. Transect VI - 34

2. Total through Diving - 41

a. Florida Middle Ground (FMG) - 41
b. Clearwater (CW) -"

B. Prospective "New" Species

Awaiting examination and comparison with type material.

C. New Distribution Records

1. Dredge/Trawl

a. *Euphrosine triloba*

2. Diving

D. Predominant Species at Each Station

1. Dredge/Trawl

IA	*Eunice* sp. A, *Eunice antennata*, *Ceratoneris mirabilis*
IB	*Polyodontes* sp. A
IC	*Aphrodita* sp. A, *Armandia maculata*, *Sabella melanostigma*
11A	*Pomatoceros americanus*, *Eunice antennata*, *Nereis* sp. A
IIB	*Eunice rubra*, *Phyllodoce groenlandica*, *Thelepus setosus*
IIC	*Polyodontes lupina*
111A	*Eunice rubra*, *Hermenia verraculosa*, *Spirobranchus giganteus*
IIIB	*Vermiliopsis* sp. A, *Nereis* sp. A, *Eunice*sp.A
IIIC	*Potogenia sericoma*

IVA Eunice sp. A, Eunice antennata, Ceratoneris mirabilis
IVB Eunice sp. A
IVC Hydroides protulicola, Eunice rubra
VA Hermodice carunculata, Eunice sp. A, Eunice rubra
VB Melinna maculata, Glycera americana
VC Eunice sp. A, Eupanthalis kinbergi, Sabellid sp.
VIA Pseudovermilia sp. A
VIB Eunice sp. A, Phyllodoce groenlandica
VIC Eupanthalis kinbergi, Lepidametria commensalis
(spp. of Eunicidae dominate both in numbers and Biomass)

2. Diving

FMG - all stations
Eunice rubra, Ceratoneris mirabilis, Hermenia verraculosa, Spirobranchus giganteus
(spp. of Eunicidae dominate both in numbers and Biomass)
CW - all stations

VII. Porifera

A. Number of species recorded to date - 48

1. Total from Dredge/Trawl to date - 30

2. Total from Diving - 48

a. Florida Middle Ground (FMG) - 41
b. Clearwater (CW) - 12

B. Prospective "New" Species

Prosuberites sp.
Cliona sp.
We anticipate many more

C. New Distribution Records

1. Dredge/Trawl

2. Diving

a. Verongia cauliformis rufa
b. Aeglas dispar
c. Erylus sp.
d. Pseudoceratina crassa
e. Thalysias sp.
f. Pseudaxinella lunaecharta
g. Guitara sp.
h. Spongosorites

i. _Erallax_
j. _Anteropas_ sp.
k. _Yvesia_ sp.
l. _Grayella_ sp.
m. _Prosuberites_ sp.
n. _Cliona_ sp.

D. Predominant Species at each Station

1. Dredge/Trawl

2. Diving

FMG - _Ircinia strobilina_, _Cinachyra_ sp., _Pseudoceratina crassa_
CW - Names not established

VIII. _Algae_

A. Number of species recorded over all - 194

1. Total through _Dredge/Trawl_ - 106

a. Transect I - 25
b. Transect II - 72
c. Transect III - 41
d. Transect IV - 13
e. Transect V - 16
f. Transect VI - 0

2. Total through _Diving_ - 164

a. Florida Middle Ground (FMG) - 163
b. Clearwater (CW) - 71

B. Prospective "New" Species

We anticipate at least eleven (11) new species and two (2) new genera.

C. New Distribution records

We report that about 99 species have been added to those Cheney and Dyer (1974) reported.

D. Predominant Species at Each Station

1. Dredge/Trawl

IA Halymenia floridana, Gracilaris mammillaris, Caulerpa mexicana

IIA Caulerpa sertularioides, Pseudocodium floridanum, Halymenia floridana

111A Caulerpa sertularioides, Halymenis floridana, Pseudocodium floridanum

IVA Halymenia sp., Gracilaria mammillaris, Agardhinula b r own eae

VA Gracilaris mammillaris, Rhodymenia pseudopalmata, Sargassum filipendula

2. Diving

FMG #147

Botryocladia occidentalis, Codium carolinianum, Halimeda discoidea

#47

Laurencia intricata, Dictyota bartayresii, Codium carol inianum

#146

Codium intertextum, Halimeda discoidea, Betryocladia occidentals

#151

Laurencis intricata, Codium intertextum, Codium carolinianum

#251

Halimeda discoidea, Galaxaura squalida, Botryocladia occidentalis

#247

Codium intertextum, Halimeda discoidea, Kalymenia perforata

#64

Pseudocodium floridanum, Caulerpa sertularioides, Gracilaria mammillaris

#62

Caulerpa sertularioides, Udotea conglutinata, Halimeda cf. tuna

FISH FAUNA OF THE FLORIDA MIDDLE GROUND (FMG)

Through the exclusive use of SCUBA our diver scientists have greatly increased (by 37 species) our knowledge of the fish fauna associated with this biolithological formation.

We are able to report sightings on 134 species from 47 familes. These species may be sub-categorized as:

Primary Reef Species	78 (24 new to FMG)
Secondary Reef Species	39 (7 new to FMG)
Pelagic Species	13 (6 new to FMG)

With the encounter of these new sightings we also note that these species are apparent new records in the northeastern Gulf of Mexico.

Distribution Records

Rypticus bistrispinus

Previously recorded only from W. Atlantic including Florida Keys, Bahamas, Jamaica and Southward, Tortugas

Rypticus subbifrenatus

Previously recorded from Florida Keys, Bahamas, Jamaica, Puerto Rico, Virgin Islands, Flower Garden, Yucatan, Curs.cao

Anisotremus virginicus

Previously recorded from Florida, Keys, Bahamas, Bermuda, Central America coast south to Brazil, Tortugas

Holacanthus tricolor

Previously recorded from Florida Keys, Bahamas, Bermuda, Tortugas to southeast Brazil, West Flower Garden

Sparisoma atomarium

A redescribed species whose distribution is poorly known but from Florida Keys, Bahamas, and Western Atlantic perhaps Tortugas

Gobiosoma xanthiprora

Smith *et al*., misidentified specimens of this species as *G. horsti*. *G. xanthiprora* is known from the Florida Keys, Tortugas and off Nicaraugua

Although the diversity of FMG fishes compares well in number with other Gulf icthyofaunas:

Seven and One-Half Fathom Reef, Off Texas	57	Causey, 1969
Flower Garden Reef	128	Cashman, 1973

the composition does not favor a western Gulf affinity. It would appear that the DeSoto Canyon coupled with the outflow of the Mississippi River provides a significant influence in the separation of Northeast and Western Gulf reef fauna.

When we compare the actual number of FMG species occurring at the other sites we get the impression of' a distinct eastern gulf fish fauna which is of a Bahamian-Florida Keys origin:

Bahamas - 104 of 134
Tortugas - 99 of 134
Alligator Key - 115 of 134

as opposed to a Caribbean-Yucatan flavor as seen on the Texas coast:

Caribbean - 84 of 134
Yucatan - 45 of 134
Alacran - 45 of 134
Flower Garden - 49 of 134

and we see the DeSoto Canyon barrier - 33 of 134.

This apparent dissimilarity loses some edge, however, if we examine it with the Bray-Curtis Similarity Index whose values are recorded as follows:

B

FMG to Bahamas		32.4%
FMG to Caribbean	-	38.1%
FMG to Tortugas		34. 5%
FMG to Alligator Reef	-	35.3$
FMG to DeSoto Canyon	-	30 %
FMG to Flower Garden	-	37.4%
FMG to Alacran	-	38.6%
FMG to Yucatan	-	26.2%

Trellis Diagrams

Figures 1-5 display the Bray-Curtis similarity percentages both numerically and graphically. By arranging the stations in seriatum by depth, we develop a fairly consistant grouping for Molluscs, Decapod Crustaceans, and Echinoderms. The association of Polychaetes and of Hard/Soft Corals is not so evident.

Figure 1.

-Trellis Diagram Molluscan Fauna
MAFLA - 1975

	I A	II A	III A	IV A	V A	VI A	I B	II B	111 B	IV B	V B	VI B	I C	II C	III C	IV C	V C	VI C
I-A		40	33	44	36	28	20	16	15	7	14	20	18	“ 4	8	7	7	6
II-A			34	35	26	7	15	27	13	8	16	12	13	0	4	4	0	3
III-A				36	32	19	12	19	25	6	18	18	13	3	$	3	3	6
IV-A					44	24	17	18	18	11	14	20	14	4	4	4.-	3	6
V-A						11	28	14	11	8	13	23	14	8	0	0	4	7
VI-A							6	10	5	14	9	10	9	7	14	13	6	5
I-B								30	18	9	21	25	22	26	18	8	14	25
II-B									36	7	37	36	33	21	15	14	12	26
III-B										7	23	25	19	7	7	7	6	10
IV-B											12	12	6	22	12	10	9	7
V-B												36	21	12	12	24	21	23
VI-B													27	19	8	11	28	29
I-C														31	39	42	38	28
II-C															47	42	52	34
III-C																67	45	21
IV-C																	42	33
V-C																		41
VI-C																		

0-9 10-19 20-29 30-39 40-49 50+

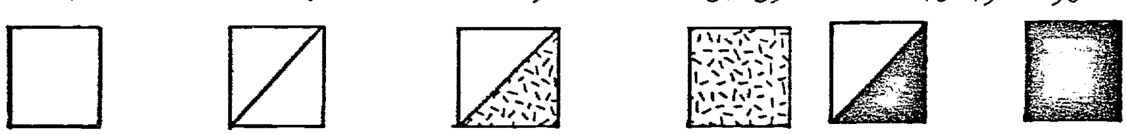


Figure 2.

Trellis Diagram Decapod Crustacean Fauna
MAFLA - 1975

	I A	II A	III A	IV A	V A	VI A	I A	II A	III A	IV A	V A	VI A	I A	II A	III A	IV A	V A	VI A
I-A		39	46	44	44	31	26	21	30	24	20	25	12	6	3	7	6	21
II-A			42	48	47	36	29	19	25	28	23	21	12	4	9	5	0	13
III-A				48	49	22	30	17	29	17	16	25	4	4	0	0	4	15
IV-A					67	28	32	23	44	19	23	24	10	4	5	'5	8	13
V-A						37	36	17	46	30	41	42	23	11	8	8	13	28
VI-A							16	39	31	28	50	30	11	12	13	13	11	16
I-B								33	47	23	27	52	32	26	14	14	16	29
II-B									44	42	48	47	32	31	13	26	13	17
III-B										36	35	53	31	13	22	14	12	22
IV-B											48	30	13	7	17	30	6	9
V-B												50	31	21	16	25	19	27
VI-B													44	28	26	22	19	42
I-C														53	32	33	37	56
II-C															67	69	47	52
III-C																52	32	37
IV-C																	47	43
V-C																		52
VI-C																		

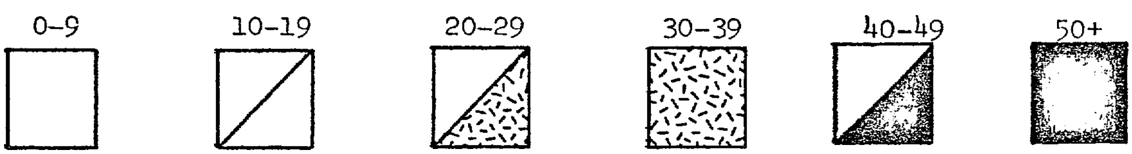


Figure 3.

Trellis Diagram Echinoderm Fauna
MAFLA - 1975

	I A	II A	III A	IV A	V A	VI A	I B	II B	111 B	IV B	V B	VI B	I C	II C	III C	IV C	V C	
I-A		69	63	59	64	32	15	9	7	10	0	0	0	0	0	0	0	
II-A			34	50	45	50	26	30	16	23	0	0	12	17	0	0	0	
III-A				43	34	21	11	3	11	3	0	0	0	0	0	0	0	
IV-A					83	33	24	18	30	0	0	0	11	14	0	.0	0	
V-A						25	17	10	16	0	0	0	0	0	0	0	0	
VI-A							12	14	11	0	25	0	18	33	0	0	0	
I-B								48	54	33	38	54	11	15	0	14	0	
II-B									52	2"(	31	52	13	17	0	0	0	
III-B										30	44	36	10	13	0	0	0	
IV-B											0	0	17	29	0	0	29	
V-B												44	0	0	0	0	0	
VI-B													0	0	25	0	0	
I-C														29	0	0	0	
II-C															0	0	0	
III-C																0	0	
Iv-c																	0	
V-C																		
VI-C																		

0-9 | 10-19 | 20-29 | 30-39 | 40-49 | 50+

Figure 4.

Trellis Diagram of Polychaeta Fauna
MAFLA - 1975

	I A	II A	III A	IV A	V A	VI A	I B	II B	III B	IV B	V B	VI B	I C	II C	III C	IV C	V C	VI C
I-A		13	56	42	40	12	1	29	21	21	13	37	29	0	0	21	11	29
II-A			10	18	14	35	0	0	18	17	0	6	10	0	0	0	0	0
III-A				37	44	20	6	22	7'0	17	21	31	23	6	3	11	19	19
IV-A					28	0	6	6	36	3	6	8	15	6	0	2-3	0	10
V-A						26	5	5	27	10	14	39	16	5	5	5	25	29
VI-A							0	0	24	13	12	12	6	17	18	0	27	9
I-B								2'	0	22	18	17	1	33	0	40	12	12
II-B									0	20	17	8	0	c	0	36	c	0
III-B										30	18	23	22	c	0	19	15	30
IV-B											17	24	35	c	0	9	12	12
V-B												39	10	c	0	31	10	32
VI-B													25	0	0	15	19	38
I-C														14	0	22	17	17
II-C															67	25	14	0
III-C																0	15	0
IV-C																	0	22
V-C																		33
VI-C																		

P

Figure 5.

Trellis Diagram for Octocorals and Scleractinia
MAFLA - 1975

	I A	II A	III A	IV A	V A	VI A	I B	II B	III B	IV B	V B	VI B	I C	II C	III C	IV C	V C	VI C
I-A		40	42	36	40	36	25	25	27	27	18	18	0	18	18	25	0	0
II-A			16	17	0	0	0	12	12	13	0	9	0	17	0	0	0	0
III-A				29	20	10	22	15	32	24	0	19	0	19	0	0	0	0
IV-A					57	25	40	31	17	33	25	21	0	25	25	0	0	0
V-A						29	50	0	18	18	29	22	0	0	29	0	0	0
VI-A							40	31	33	33	25	42	0	0	25	40	0	0
I-B								40	22	44	40	25	0	0	40	0	0	0
II-B									47	24	46	42	.4	0	31	0	18	'0
III-B										63	17	61	:5	33	33	0	20	'2
IV-B											33	61	:5	17	33	22	0	0
V-B												11	.0	0	50	0	0	0
VI-B													:7	11	21	13	12	3
I-C														0	0	0	100	100
II-C															25	0	0	0
III-C																0	33	0
IV-C																	0	0
V-C																		67
VI-C																		

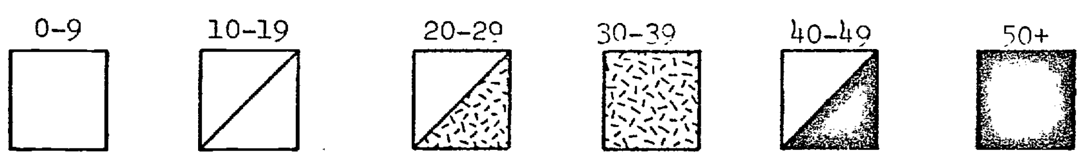


Figure 6A, 6C - Hard Coral Species Diversity and Evenness for BLM 19 and 32/34 Respectively at Station 146.

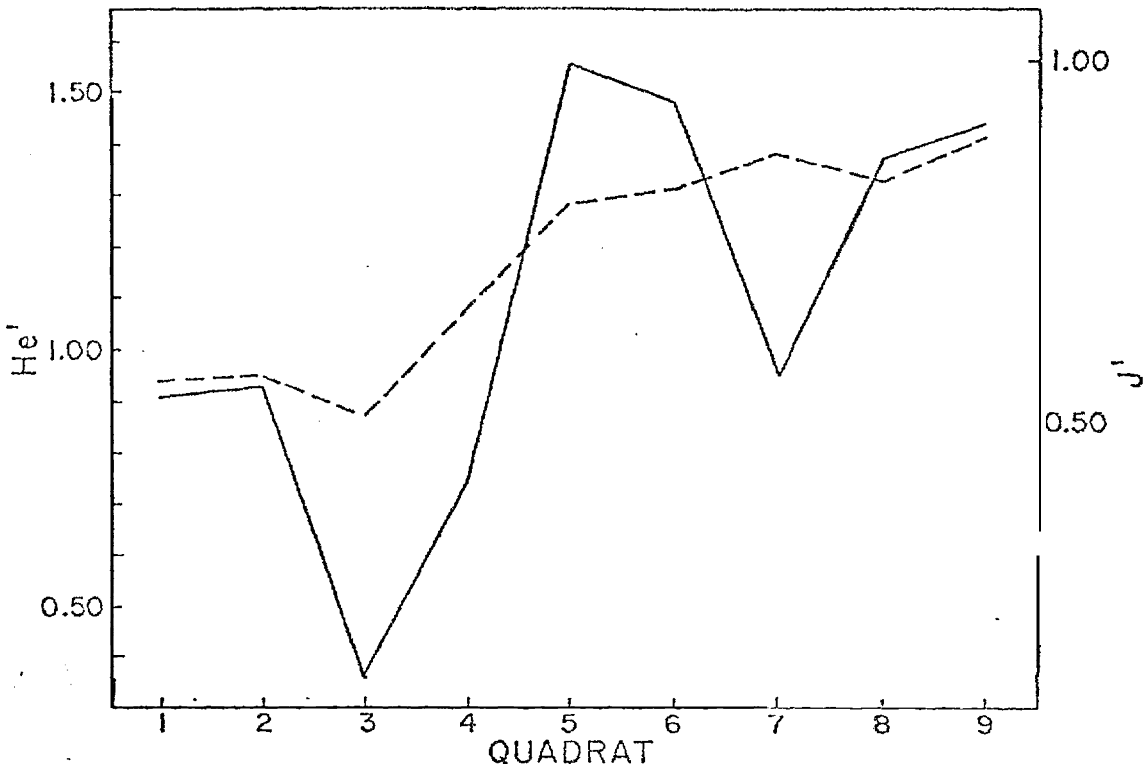
He' ________ J' ----------

Figure 6B, 6D - Hard Coral Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 146.

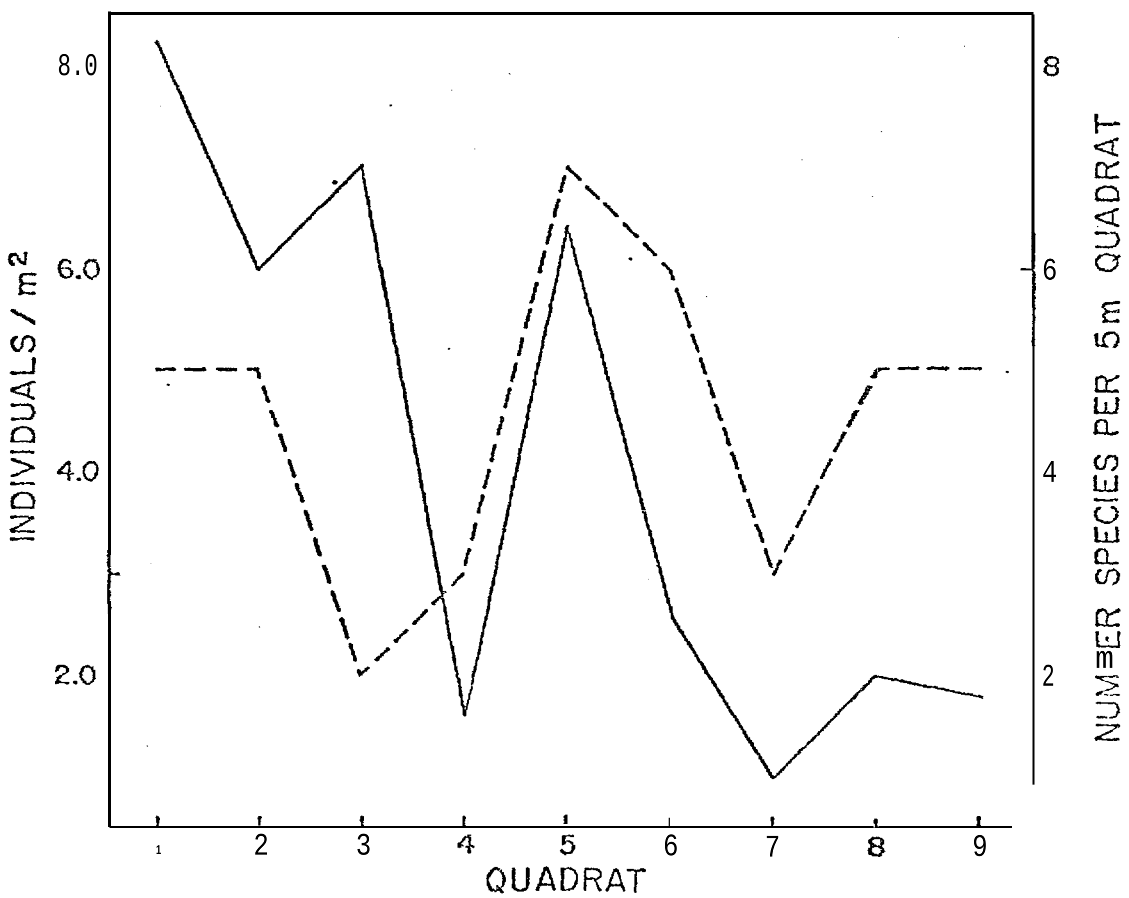
Individuals/M^2 ________ No. Species/5M Quadrat -----------

E

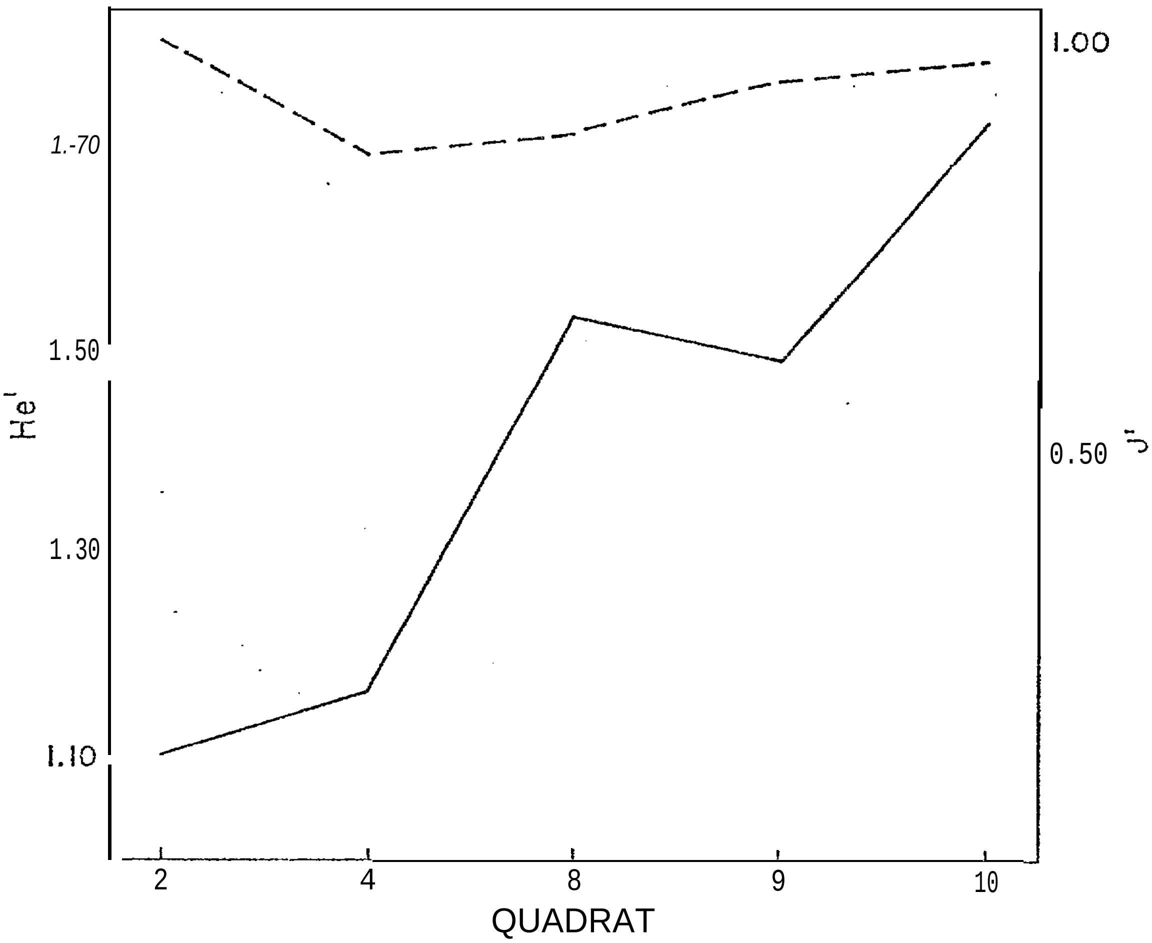
6A


1.50
1.00
0.50
He'
1.00
0.50
J'
1 2 3 4 5 6 7 8 9
QUADRAT

6B

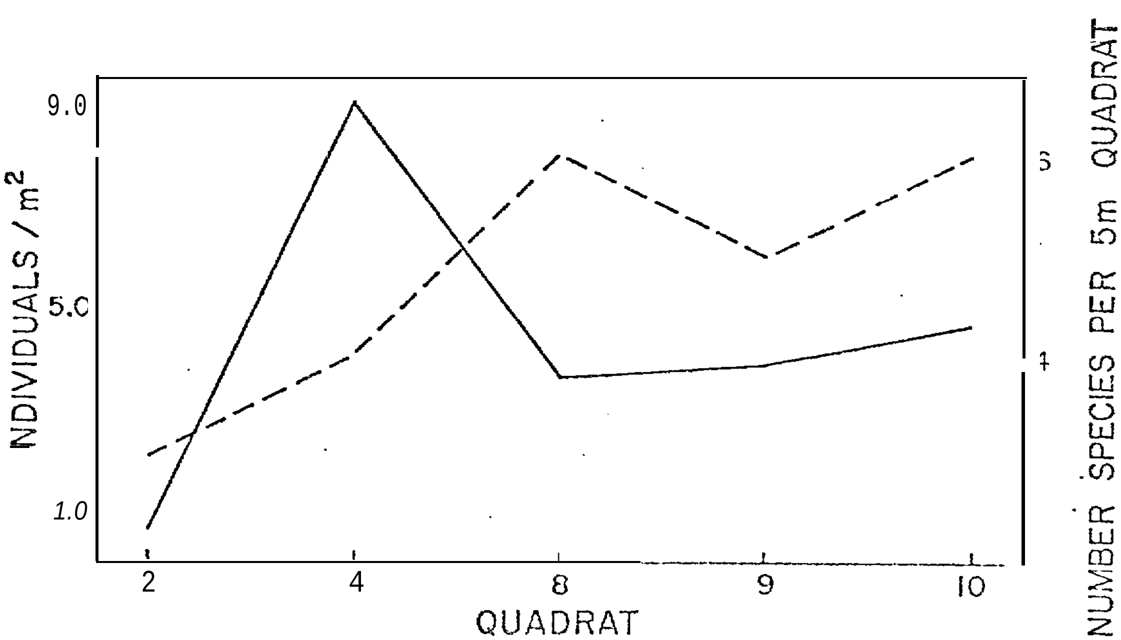

8.0
6.0
4.0
2.0
INDIVIDUALS / m²
8
6
4
2
NUMBER SPECIES PER 5m QUADRAT
1 2 3 4 5 6 7 8 9
QUADRAT

6C



1.00
1.-70
1.50
He'
0.50
J'
1.30
1.10
2
4
8
9
10
QUADRAT

6D



9.0
5.0
1.0
NDIVIDUALS / m2
NUMBER SPECIES PER 5m QUADRAT
2
4
8
9
10
QUADRAT

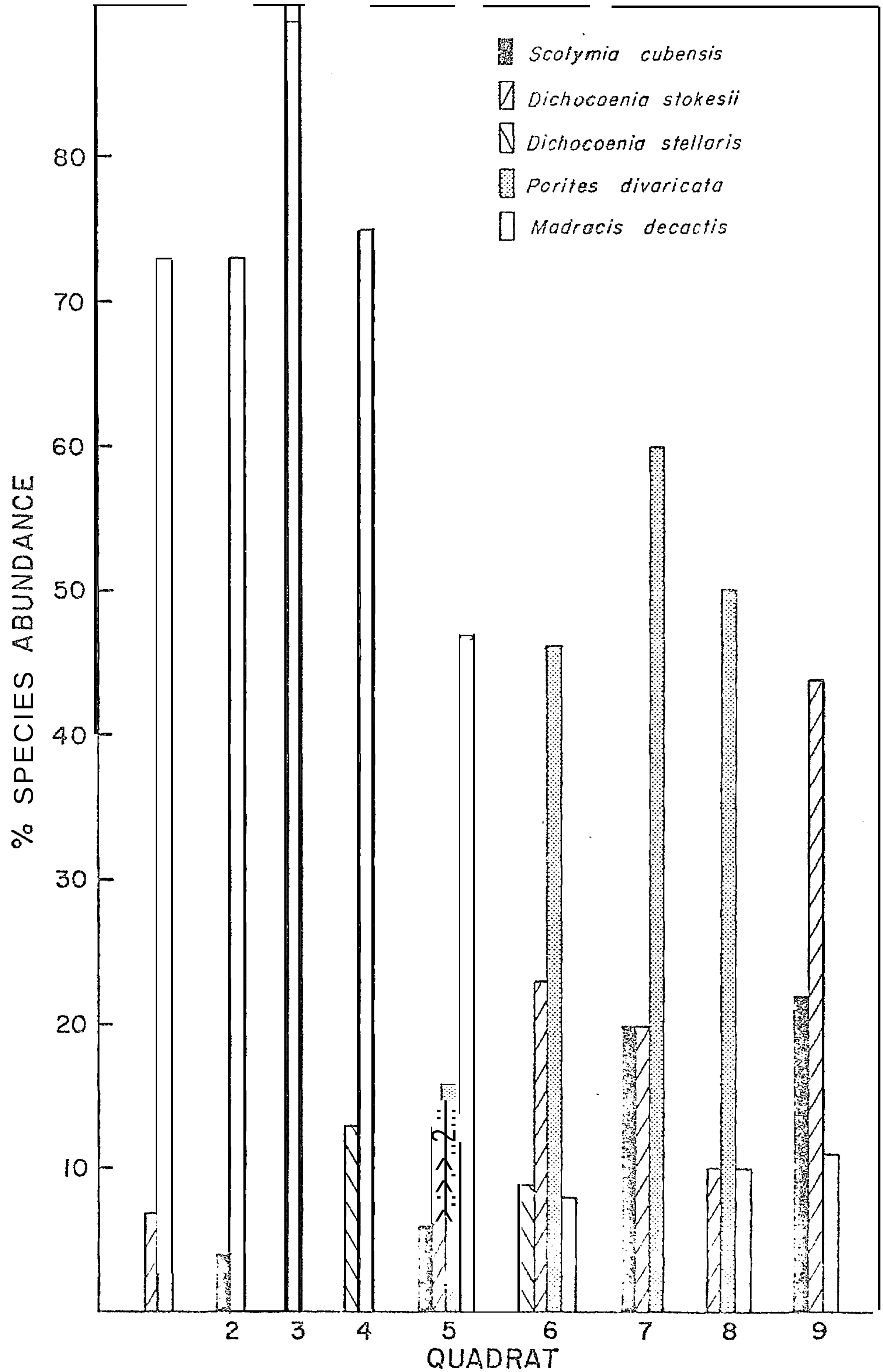


Figure 6E - Hard Coral Species Abundance, BLM 19 at Station 146.

B

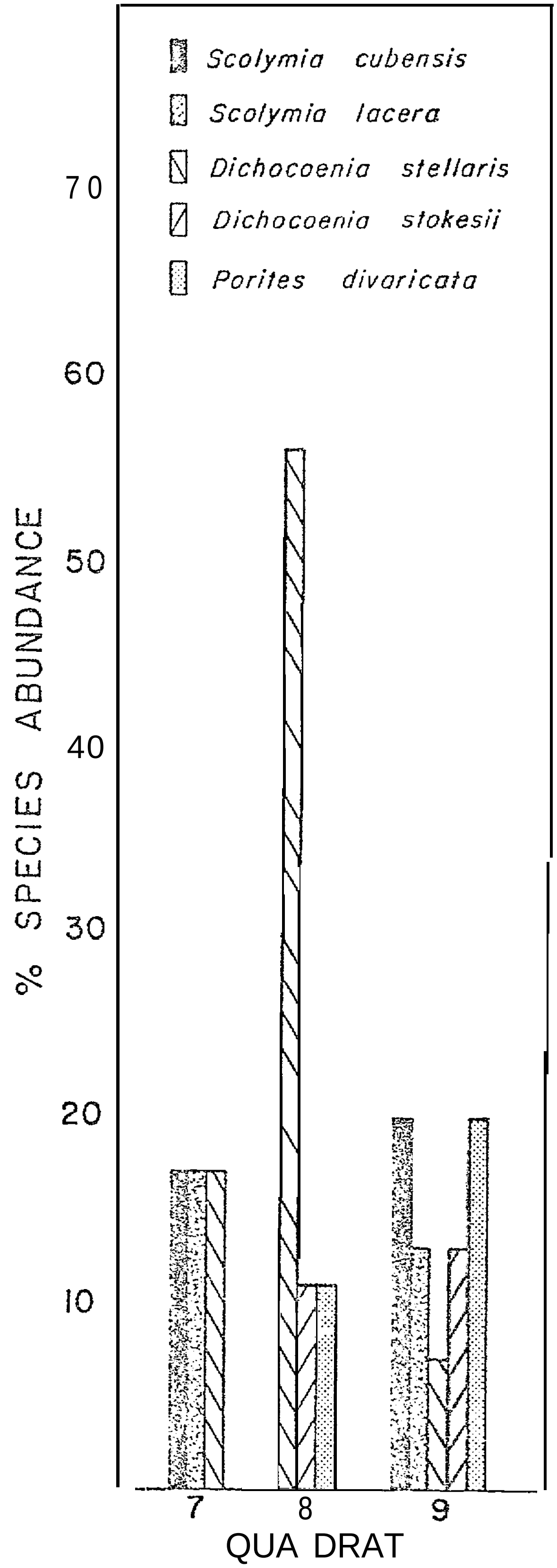


Figure 6F - Hard Coral Species Abundance, BLM 32/34 at Station 146.

B

P

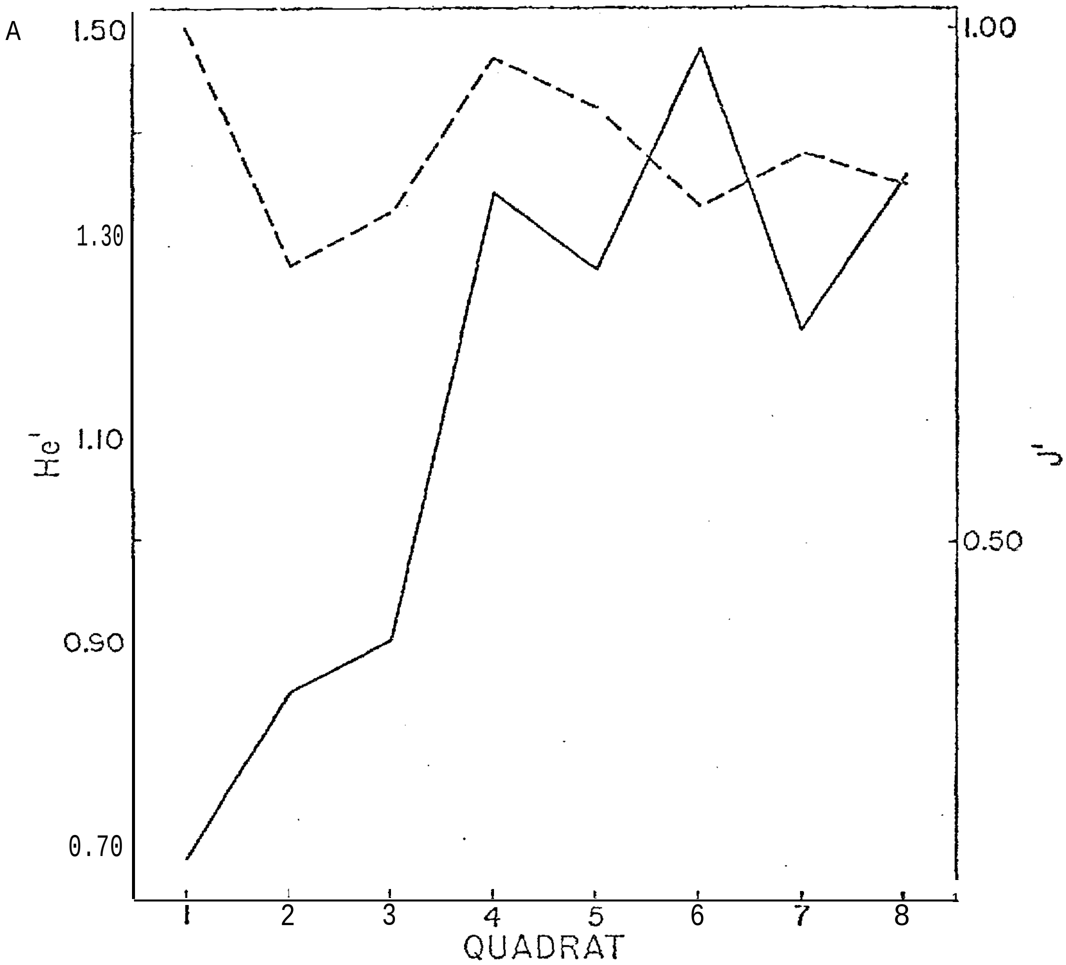
Figure 7A, 7C - Soft Coral. Species Diversity and Evenness for BLM 19 and 32/34 Respectively at Station 146.

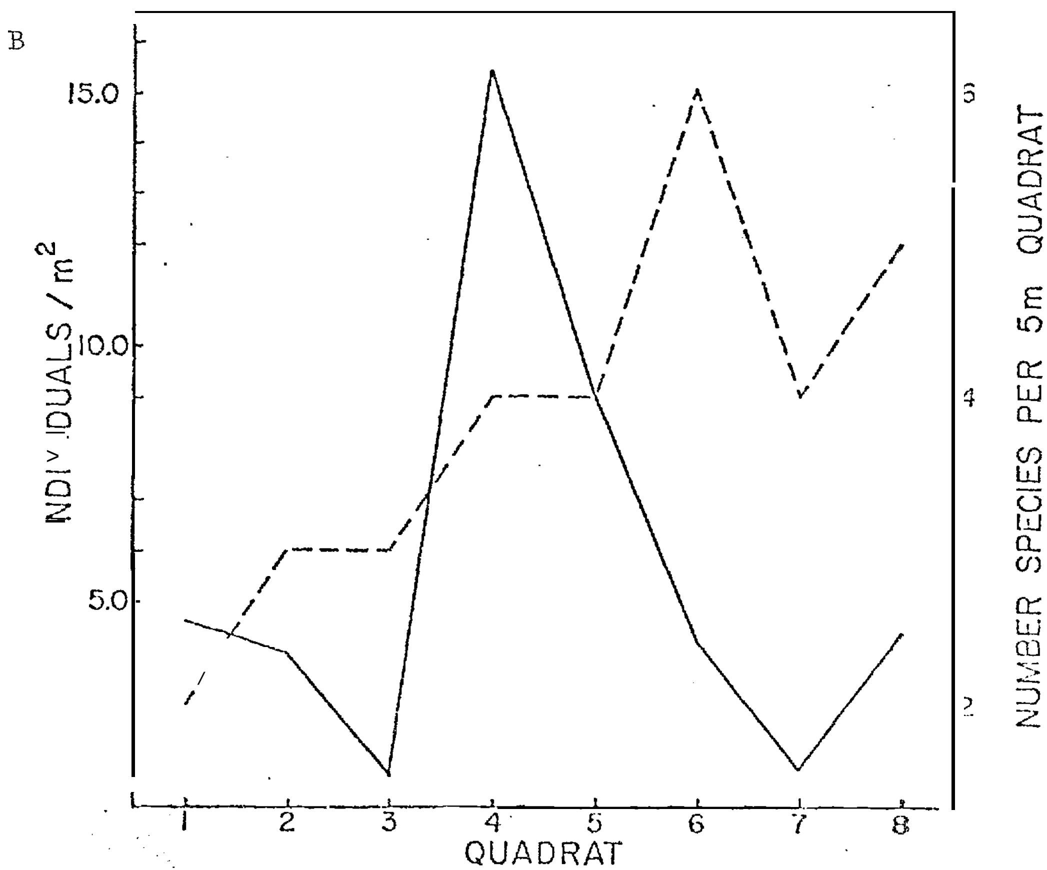
He' ______________ J' __________-____

Figure 7B, 71) - Hard Coral Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 146.

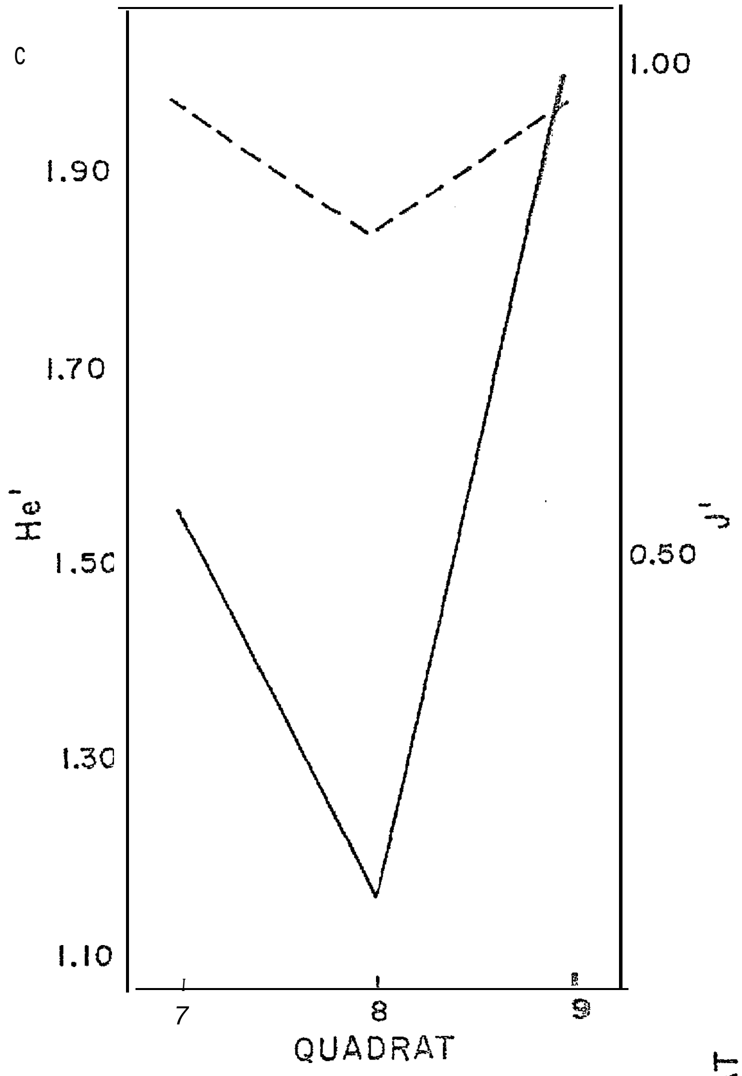
Individuals/M^2 ____________ No. Species/5M Quadrat -------------

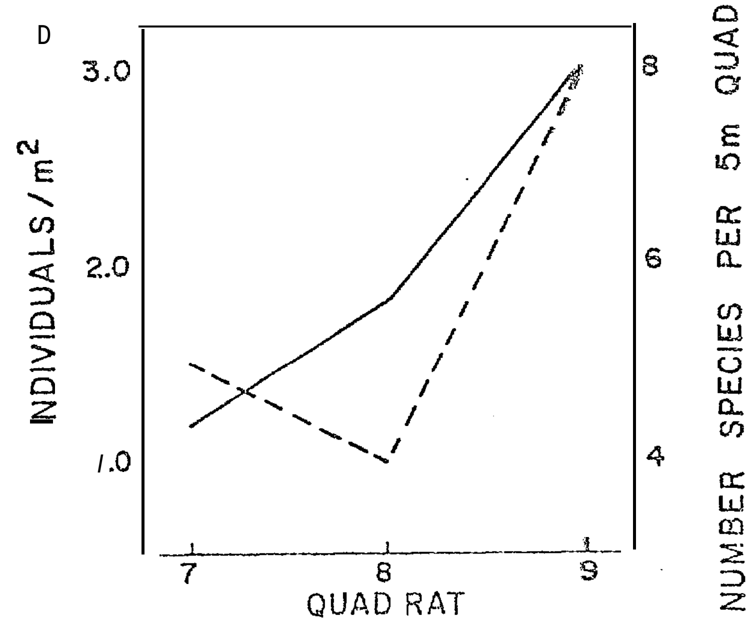
B


A
1.50
1.30
1.10
0.90
0.70
He'
1.00
0.50
J'
1
2
3
4
5
6
7
8
QUADRAT


B
15.0
10.0
5.0
NDI IDUALS / m2
6
4
2
NUMBER SPECIES PER 5m QUADRAT
1
2
3
4
5
6
7
8
QUADRAT

1465C


C
1.90
1.70
He'
1.50
1.30
1.10
1.00
0.50
J'
7
8
9
QUADRAT


D
3.0
2.0
1.0
INDIVIDUALS/m²
8
6
4
NUMBER SPECIES PER 5m QUADRAT
7
8
9
QUAD RAT

19-146

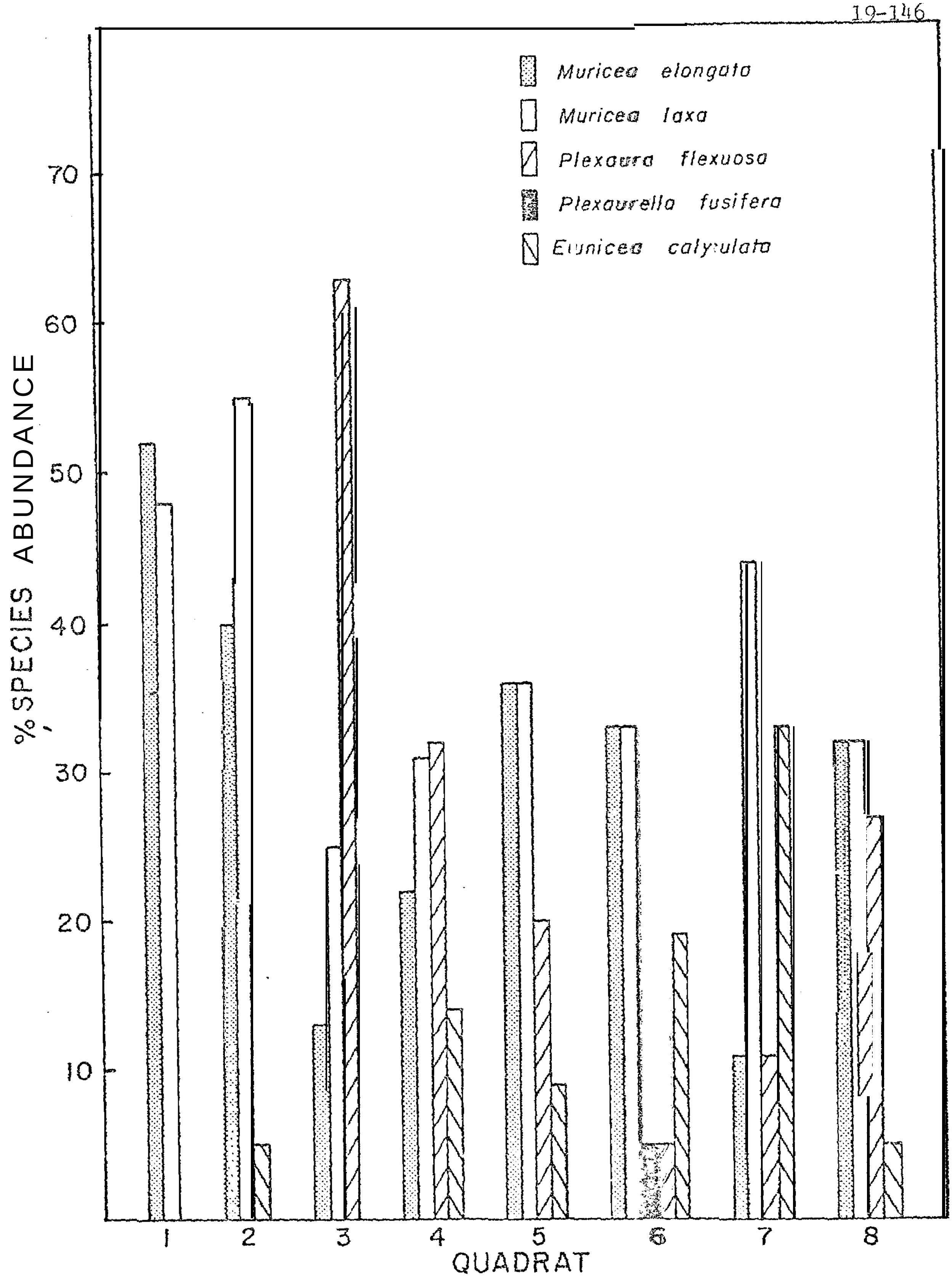


Figure 7E - Soft Coral Species Abundance, BLM 19 at Station 146.

P
B

B

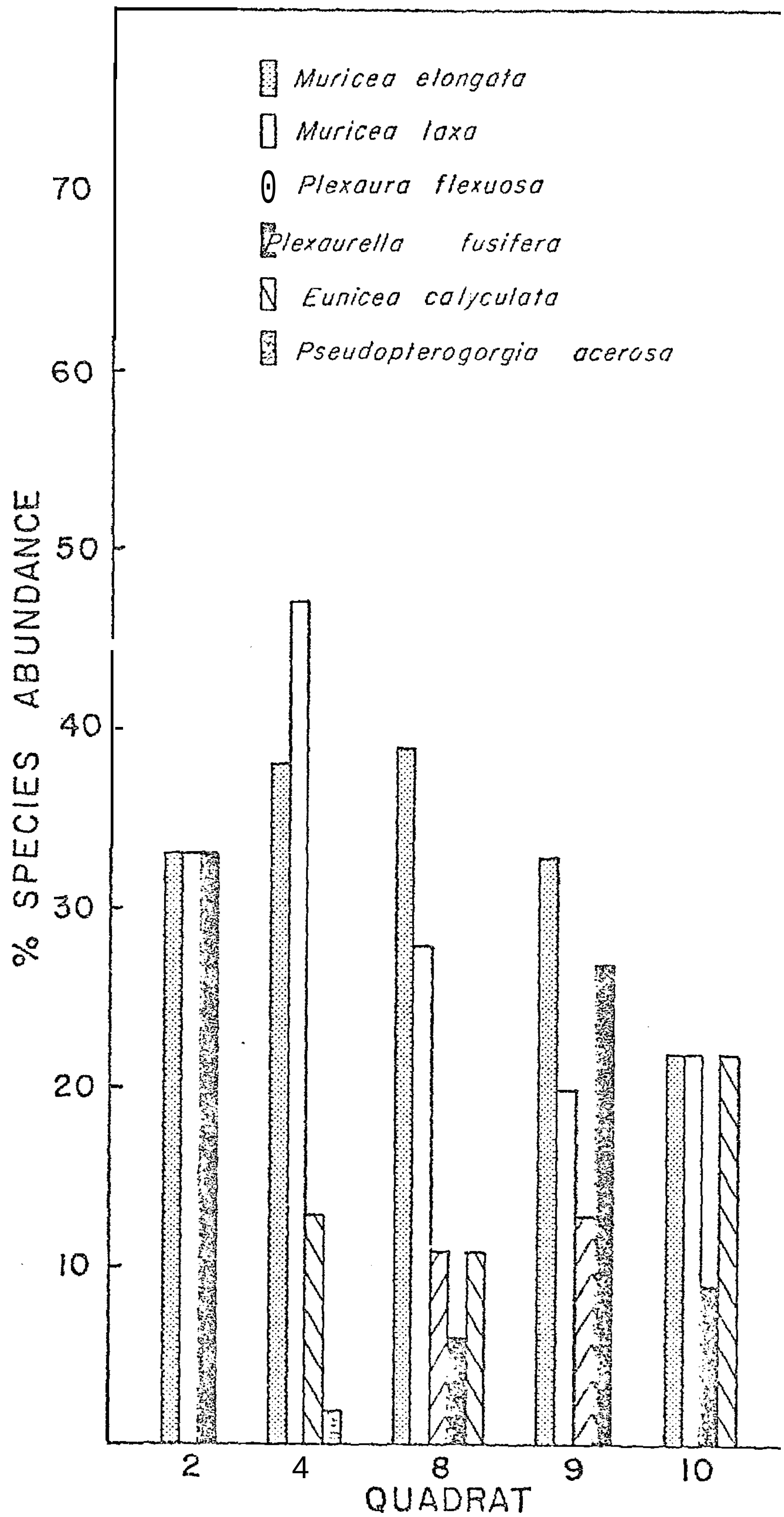


Figure 7F - Soft Coral Species Abundance, BLM 32/34 at Station 146.

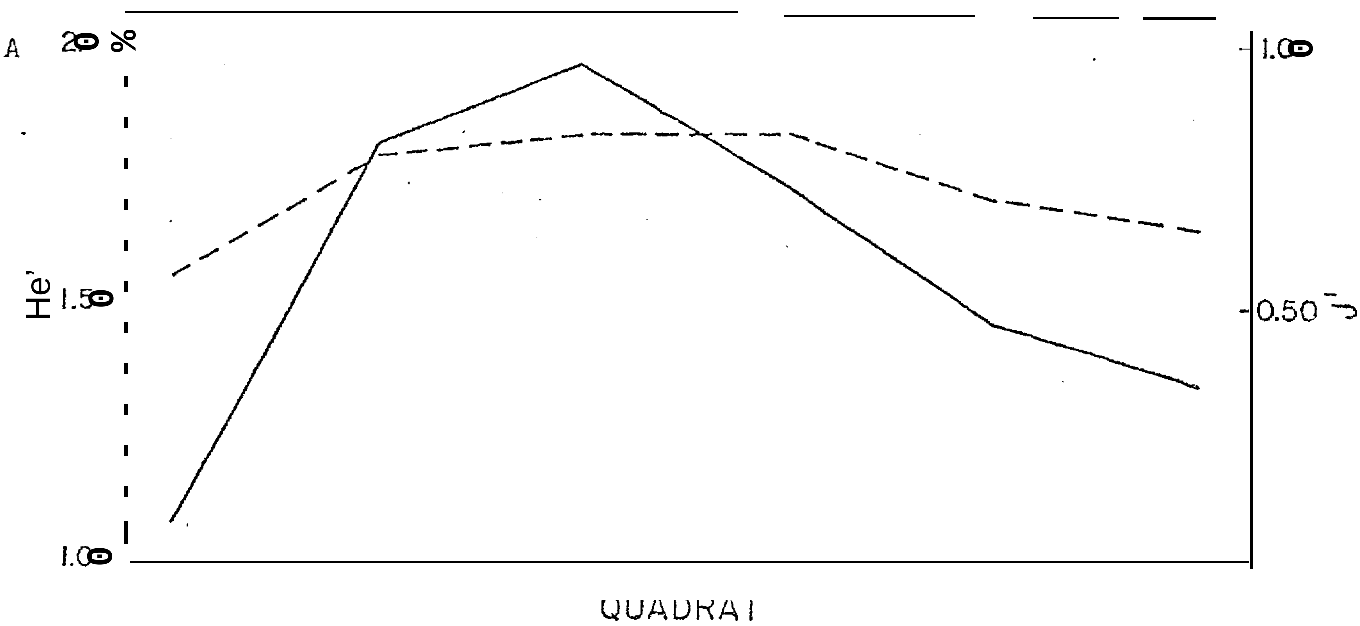
Figure 8A, 8C - Hard Coral Species Diversity and Evenness for BLM 19 and 32/34 Respectively at Station 147,

He' ___________ J' ----------

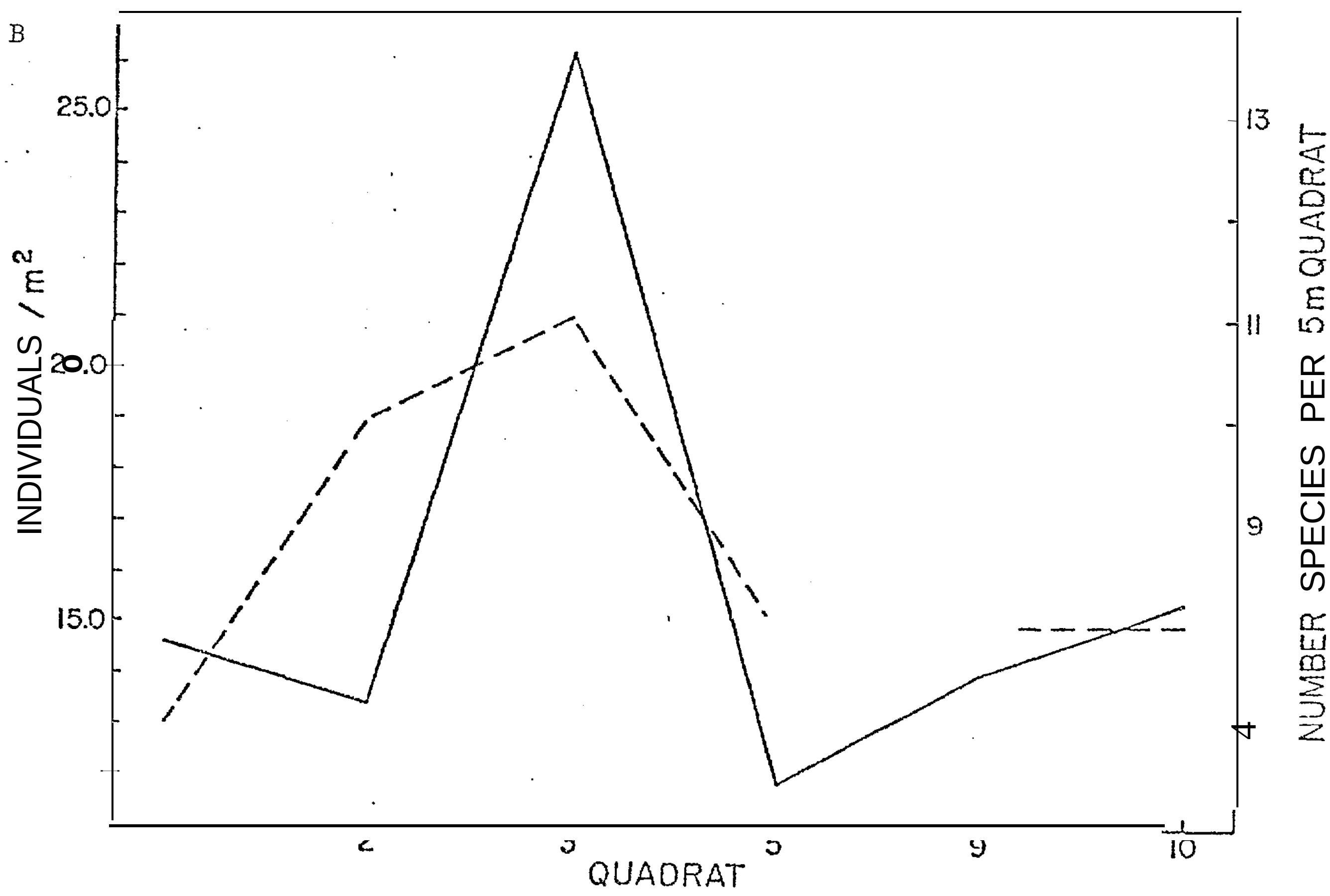
Figure 8B, 8D - Hard Coral Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 147.

Individuals/M^2 ___________ No. Species/5M Quadrat --------------

A

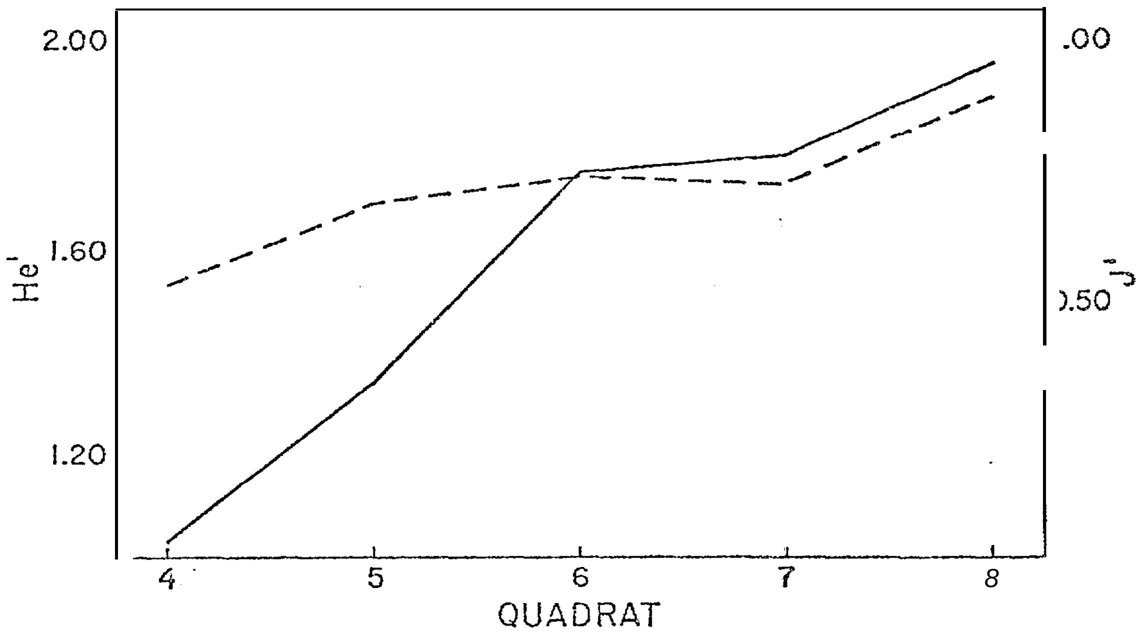

He'
2.0
1.50
1.00
1.00
0.50
J'
QUADRAT

B

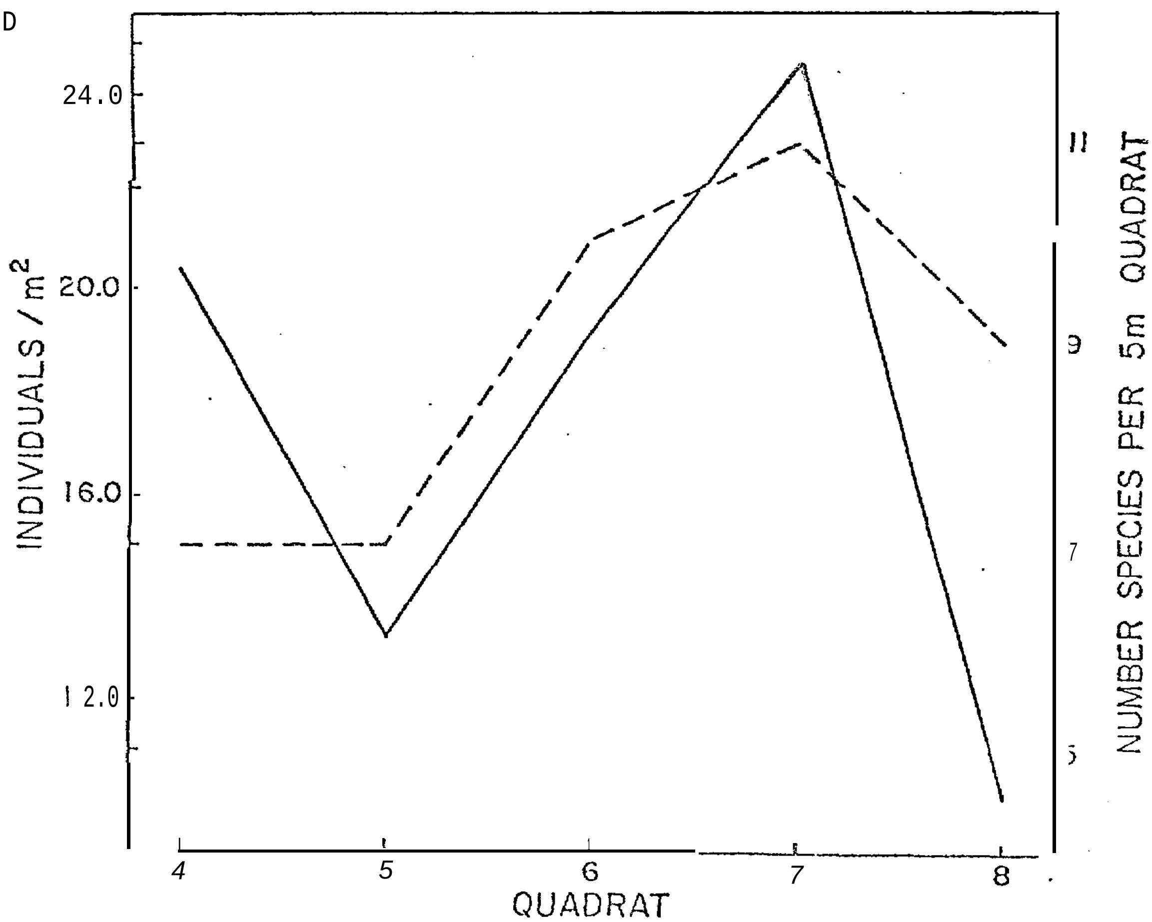

INDIVIDUALS / m²
25.0
20.0
15.0
13
11
9
4
NUMBER SPECIES PER 5 m QUADRAT
QUADRAT
10

32-147 HC

C


2.00
1.60
1.20
He'
.00
).50
J'
4
5
6
7
8
QUADRAT

D


24.0
20.0
16.0
12.0
INDIVIDUALS / m2
11
9
7
5
NUMBER SPECIES PER 5m QUADRAT
4
5
6
7
8
QUADRAT

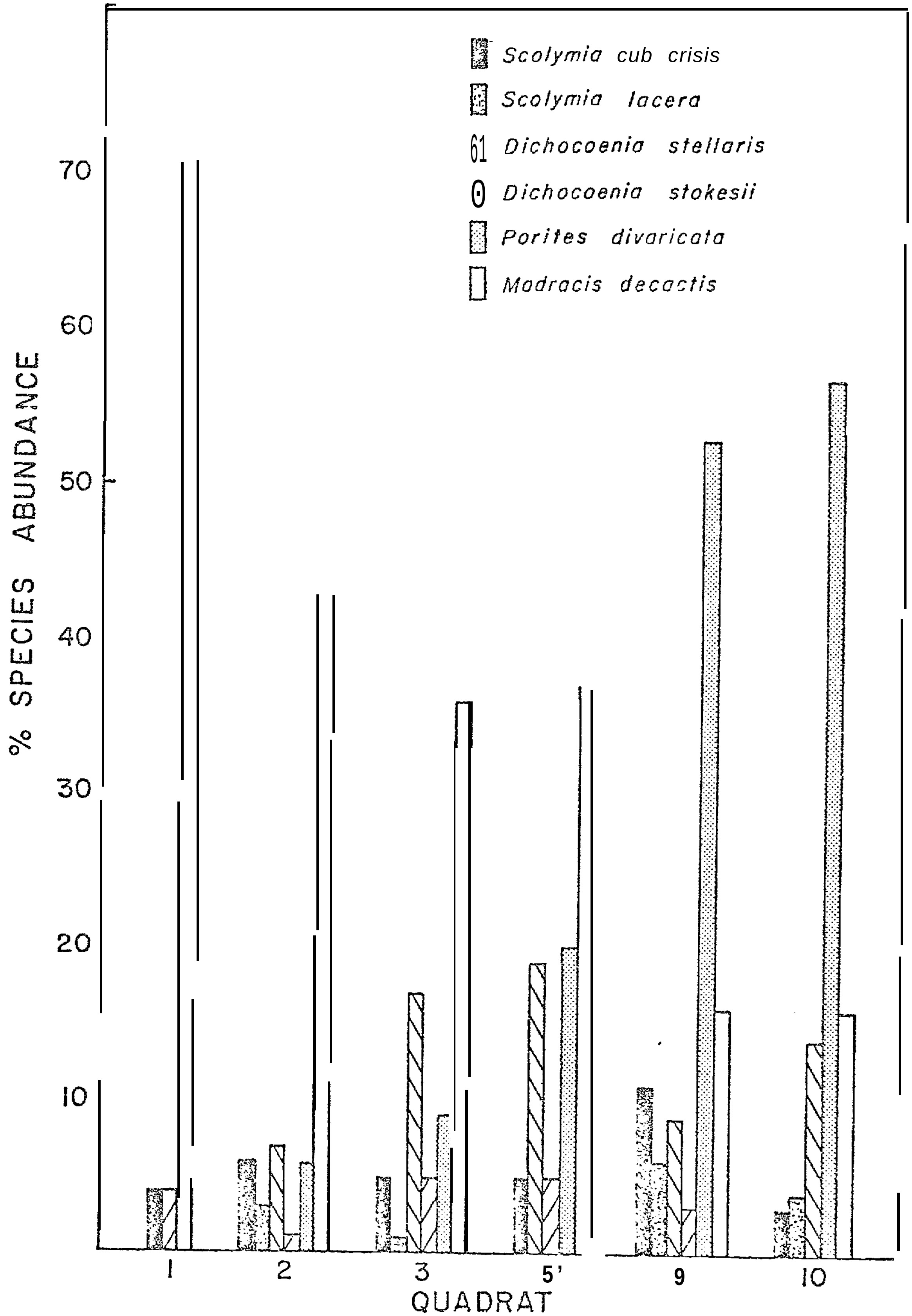


Figure 8E - Hard Coral Species Abundance, BLM 19 at Station 147.

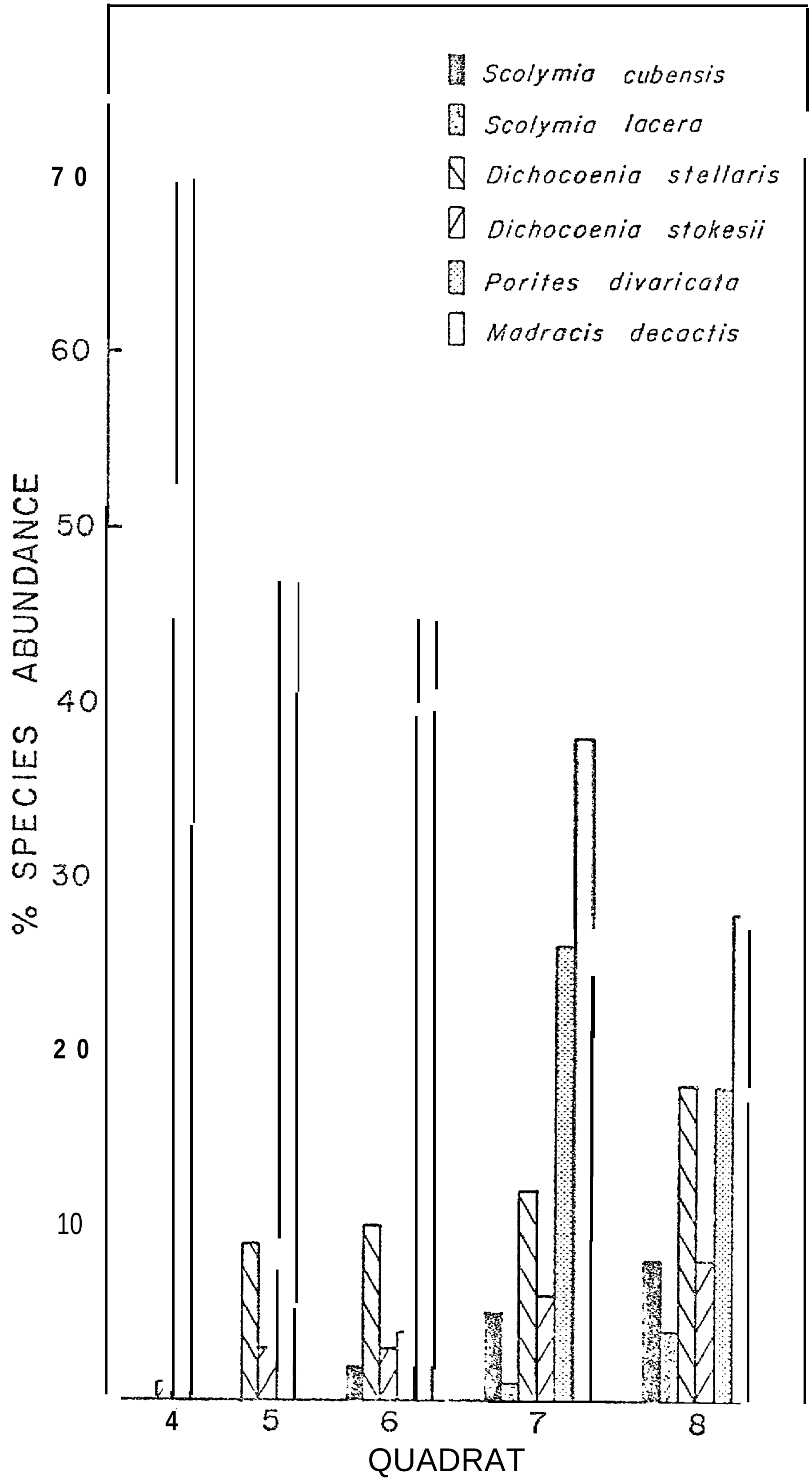
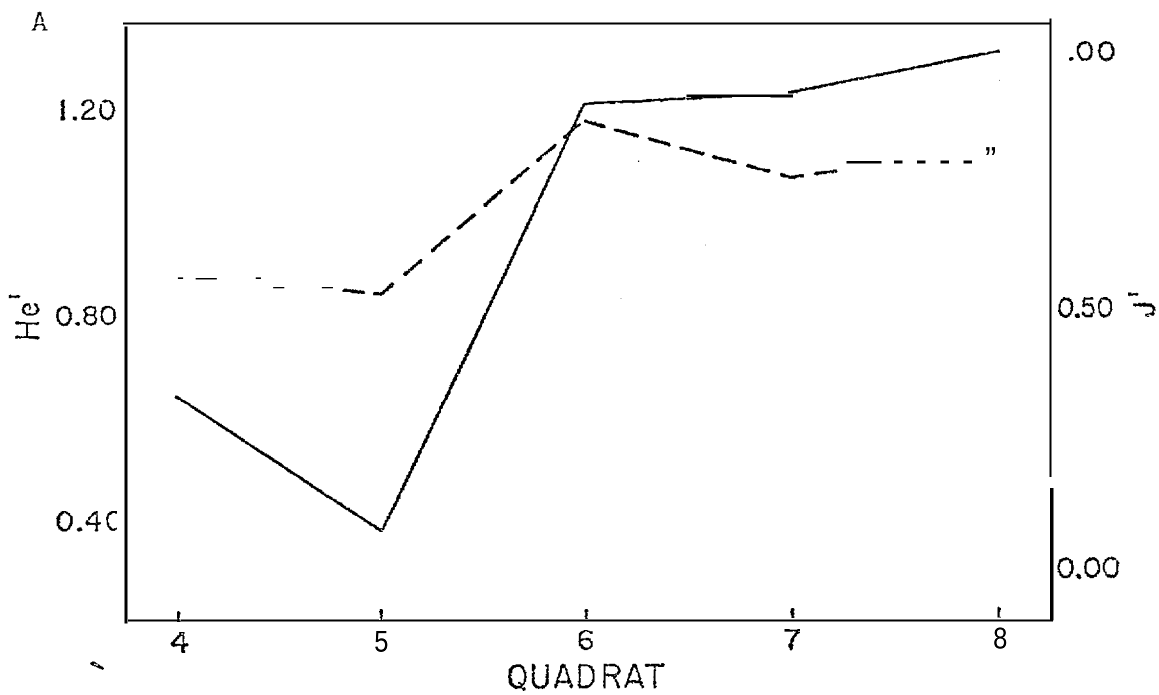
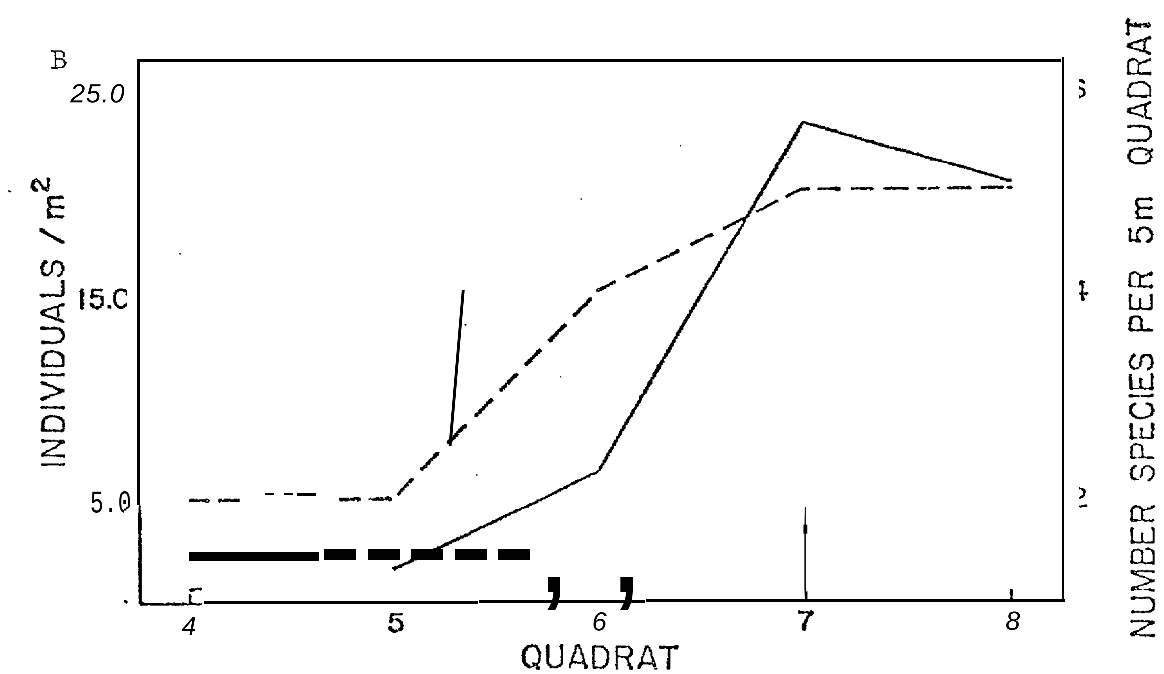


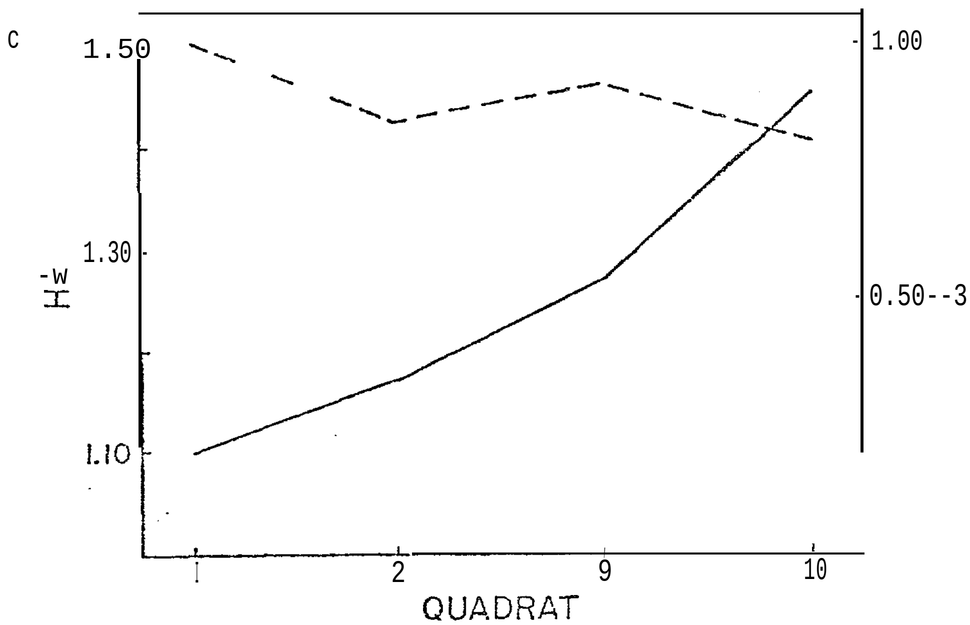
Figure 8F - Hard Coral Species Abundance, BLM 32/34 at Station 147.

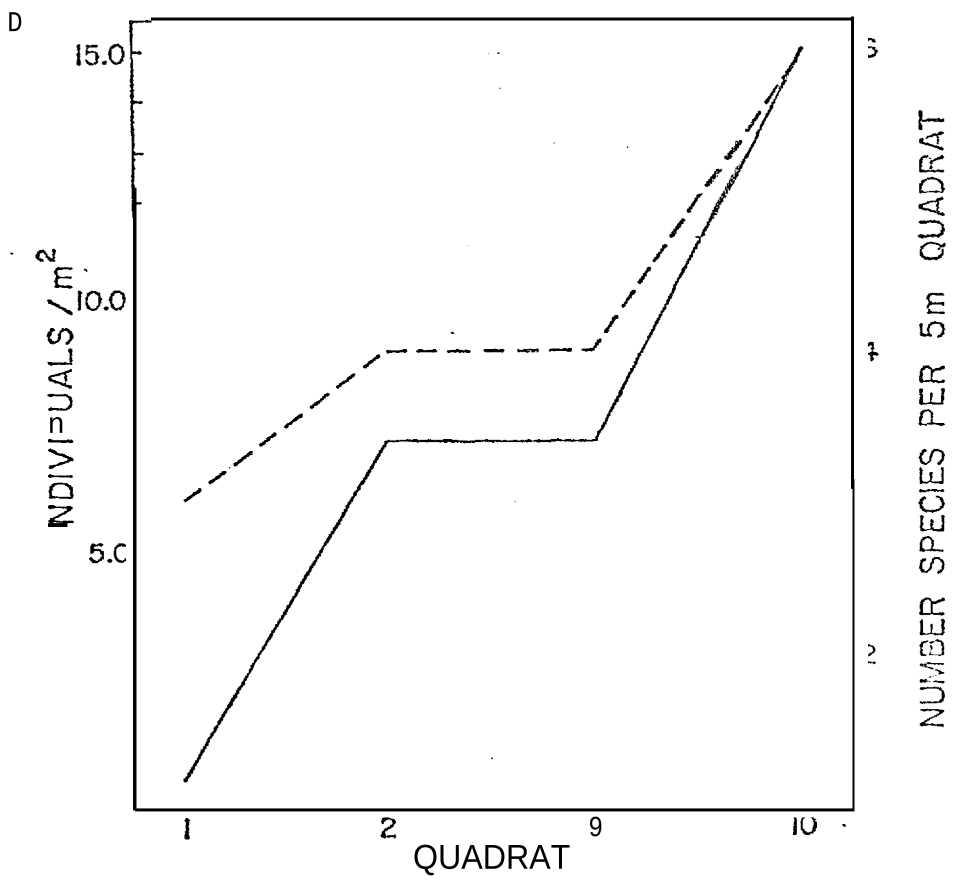
32-1.4'(Sc


A
1.20
0.80
0.40
He'
.00
0.50
0.00
J'
4
5
6
7
8
QUADRAT


B
25.0
15.0
5.0
INDIVIDUALS / m2
NUMBER SPECIES PER 5m QUADRAT
4
5
6
7
8
QUADRAT

B


C
1.50
1.30
1.10
H-W
1.00
0.50--3
1
2
9
10
QUADRAT


D
15.0
10.0
5.0
INDIVIDUALS /m2
NUMBER SPECIES PER 5m QUADRAT
1
2
9
10
QUADRAT

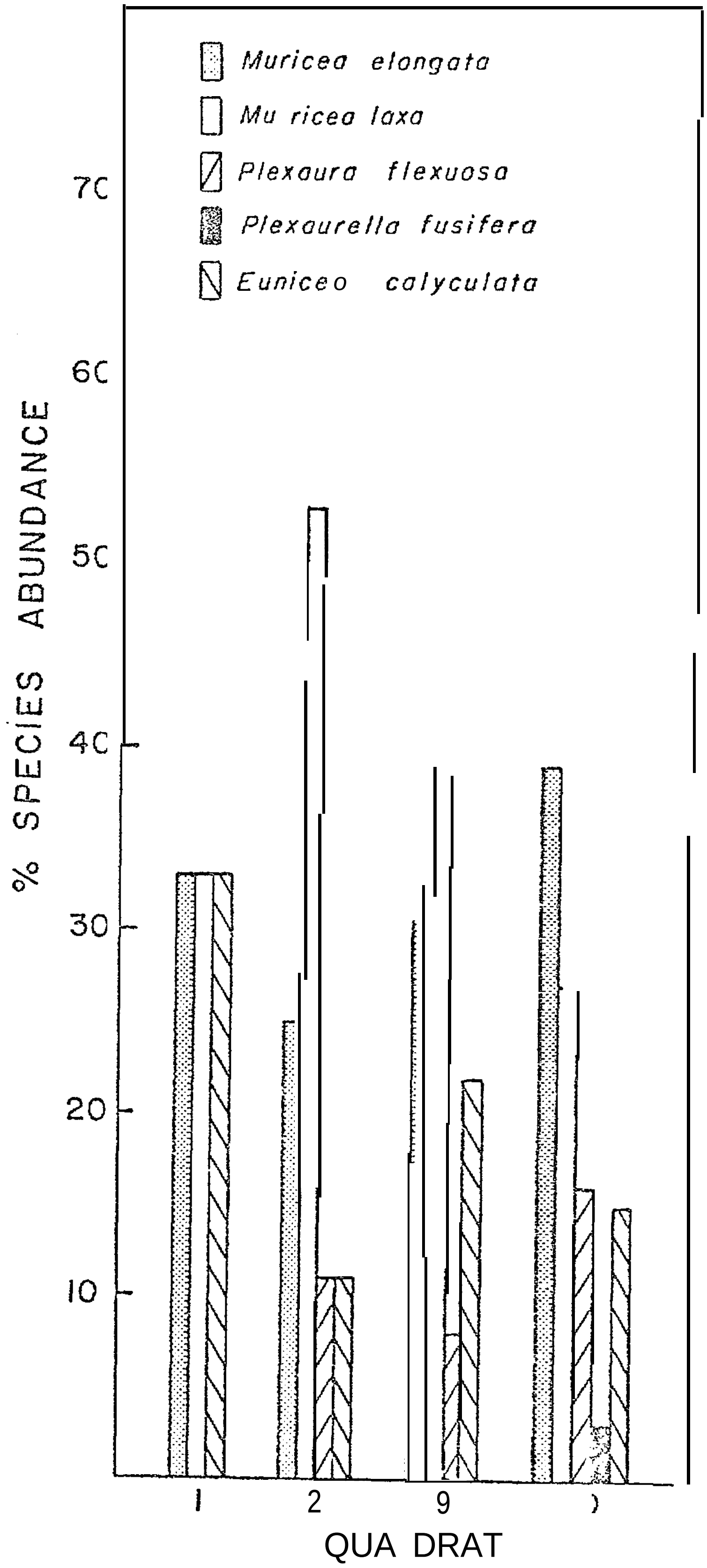


Figure 9E - Sof t Coral Species Abundance, BLM 19 at Station 147.

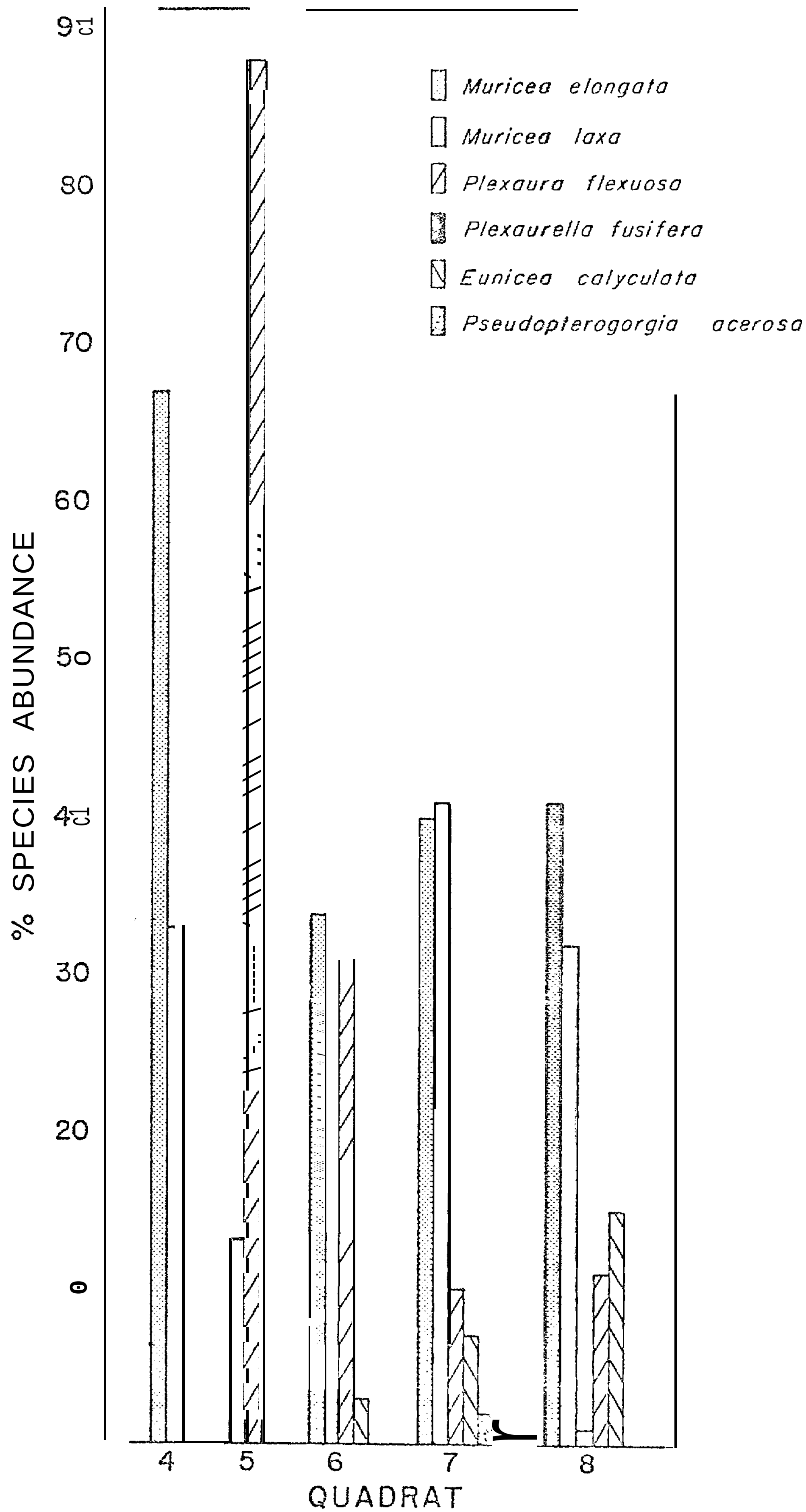


Figure 9F - Soft Coral Species Abundance, BLM 32/34 at Station 147.

B

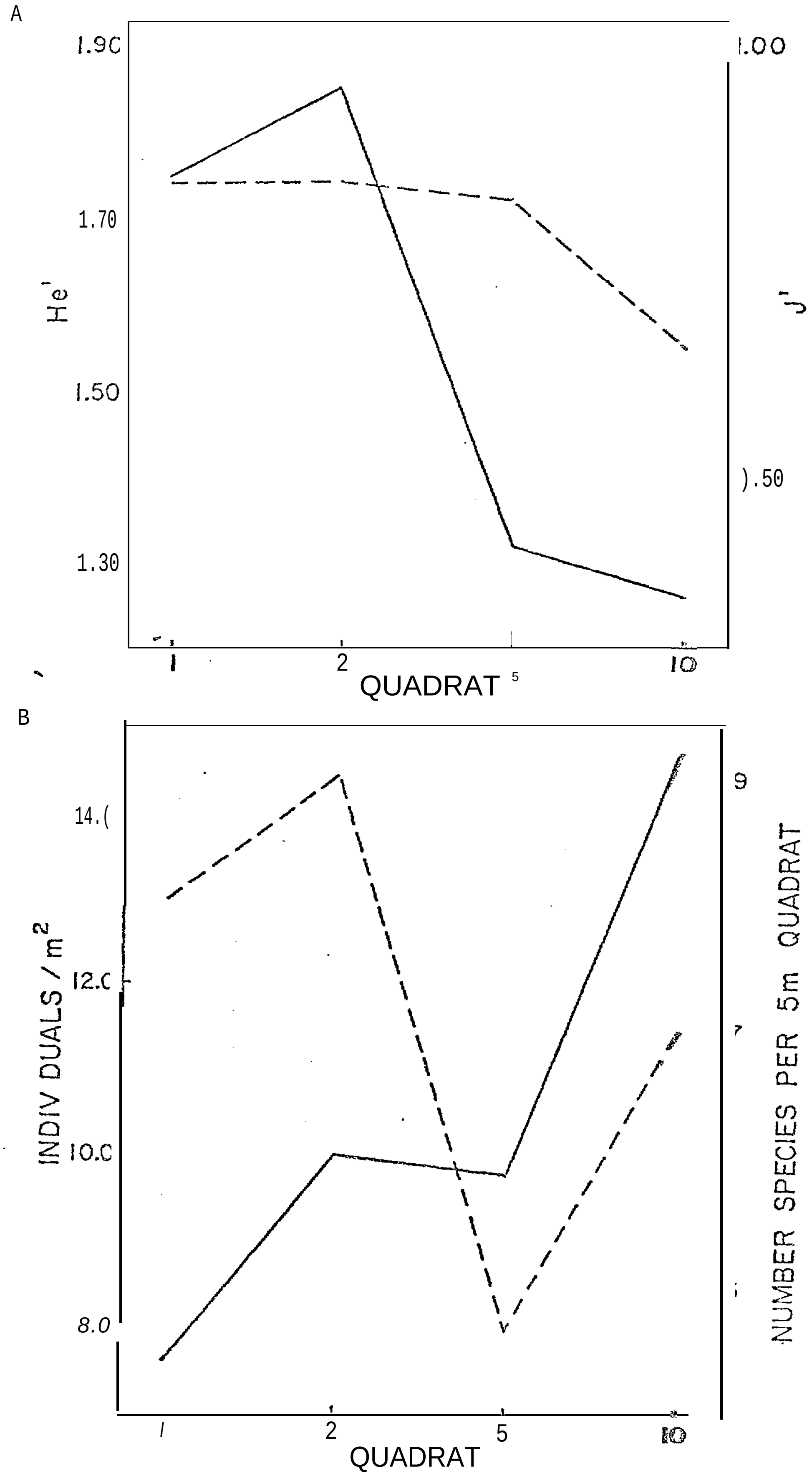
Figure lOA, 10C-Hard Coral Species Diversity and Evenness for BLM 19 ancl 32/34 Respectively at Station 047.

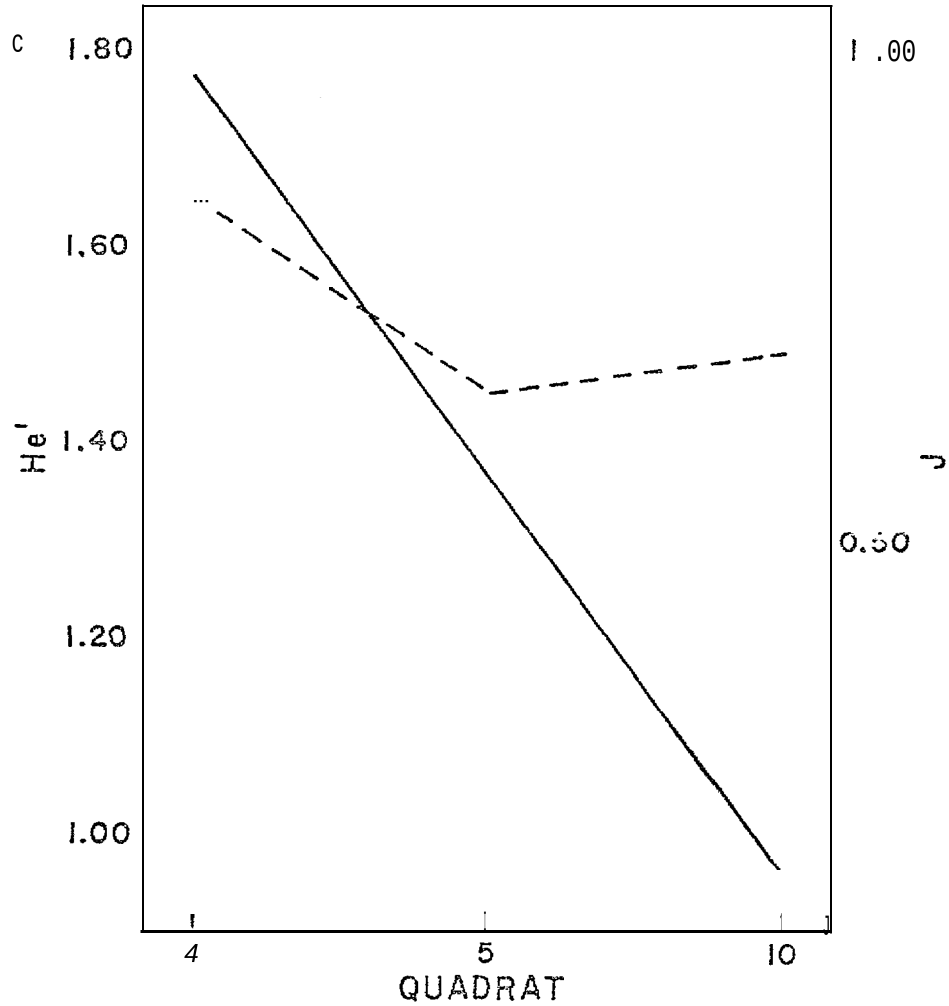
He'_ ________ J'----- ----

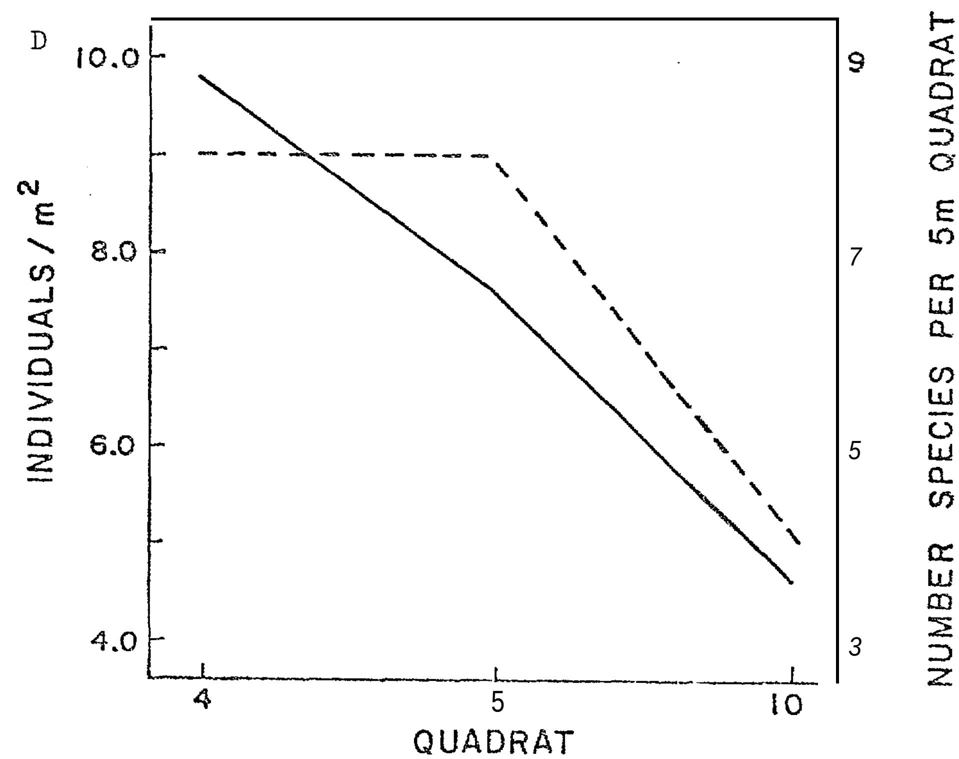
Figure 10B, 10D - Hard Coral. Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 047.

Individuals/M^2 ________ No. Species/5M Quadrat -------------

P


A
1.90
1.70
1.50
1.30
He'
1.00
).50
J'
1
2
5
10
QUADRAT
B
14.(
12.C
10.C
8.0
INDIV DUALS / m2
9
NUMBER SPECIES PER 5m QUADRAT
1
2
5
10
QUADRAT


C
1.80
1.60
1.40
1.20
1.00
He'
1.00
0.50
J
4
5
10
QUADRAT


D
10.0
8.0
6.0
4.0
INDIVIDUALS / m²
9
7
5
3
NUMBER SPECIES PER 5m QUADRAT
4
5
10
QUADRAT

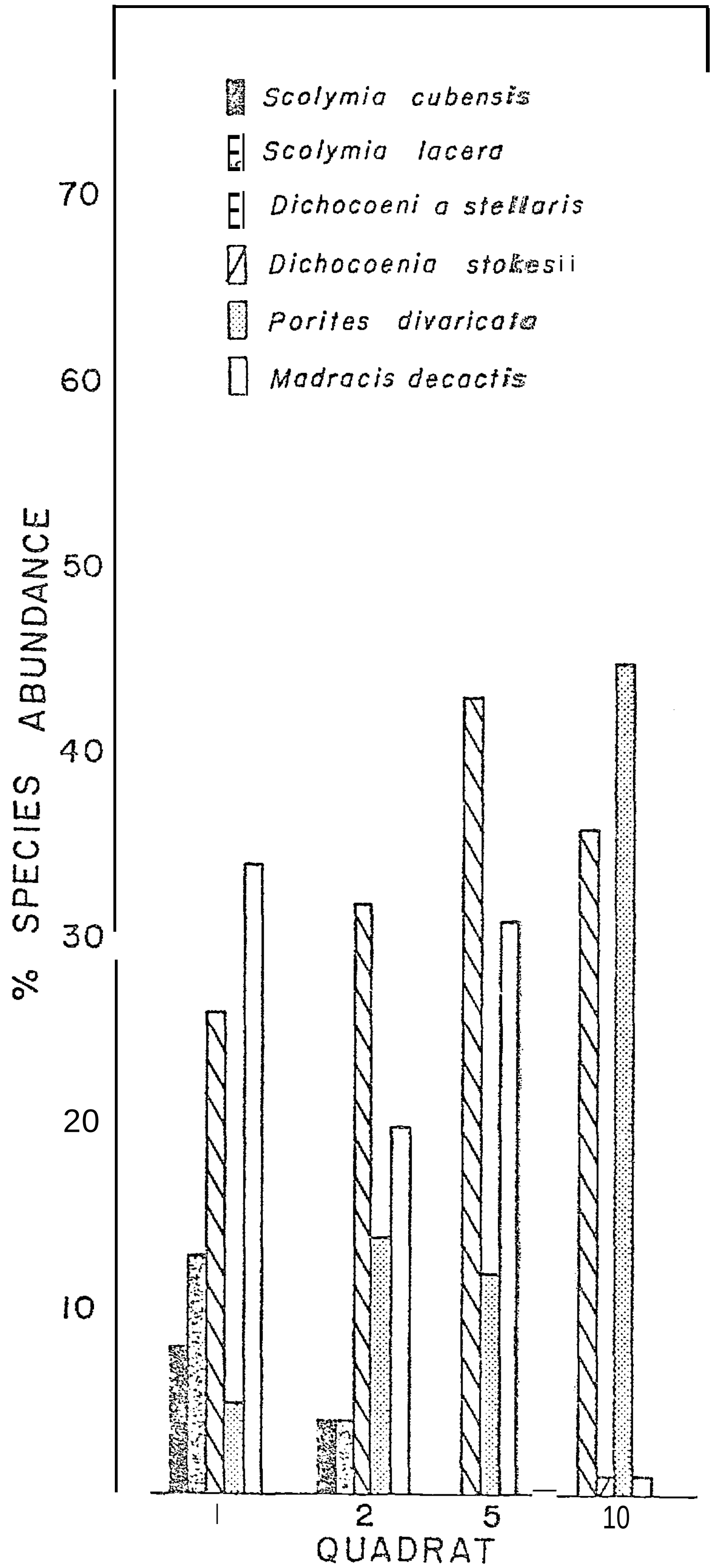


Figure 10E - Hard Coral Species Abundance, BLM 19 at Station 047 *

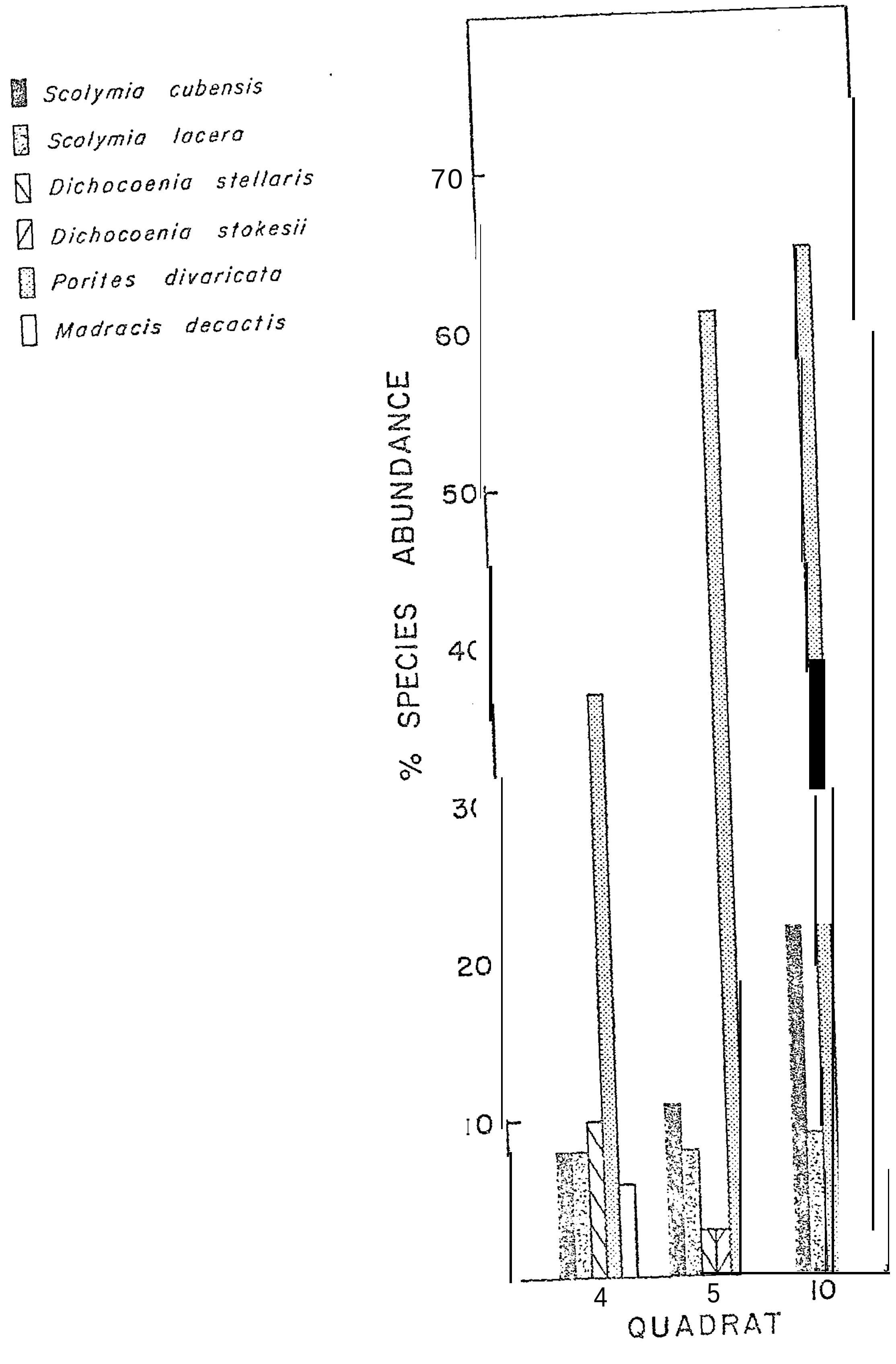


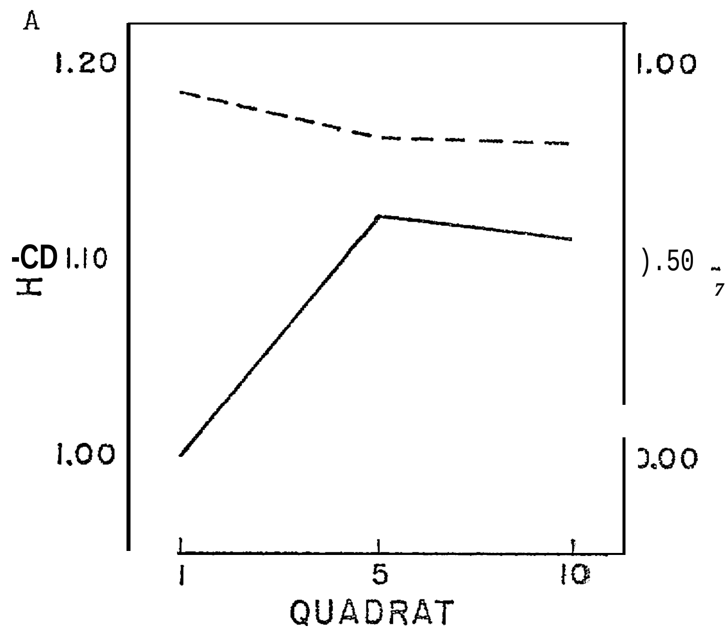
Figure 10F- Hard Coral Species Abundance, BLM 32/34 at Station 047.

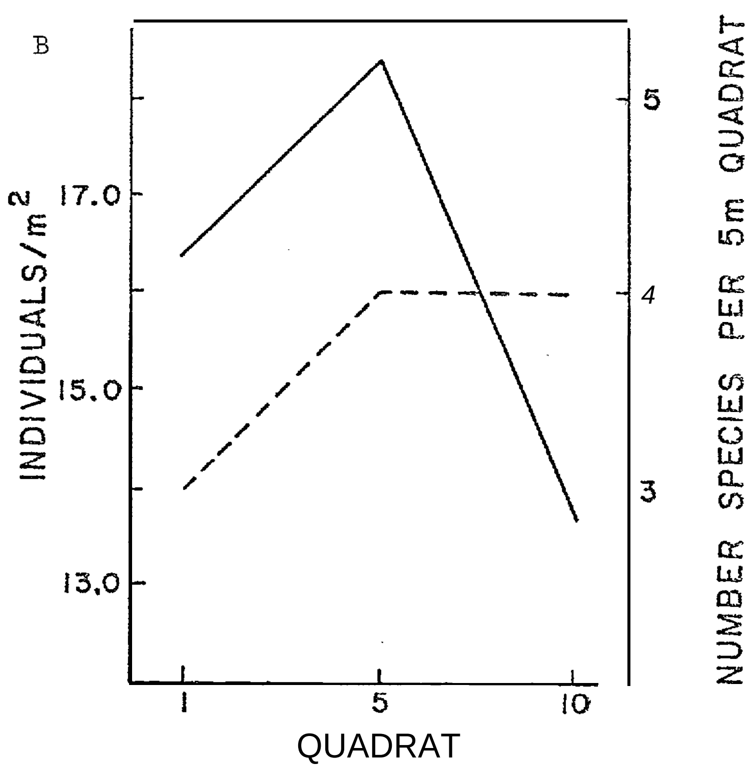
Figure 11A., 11C - Soft Coral Species Diversity and Evenness for BLM 19 and 32/34 Respectively at Station 047.

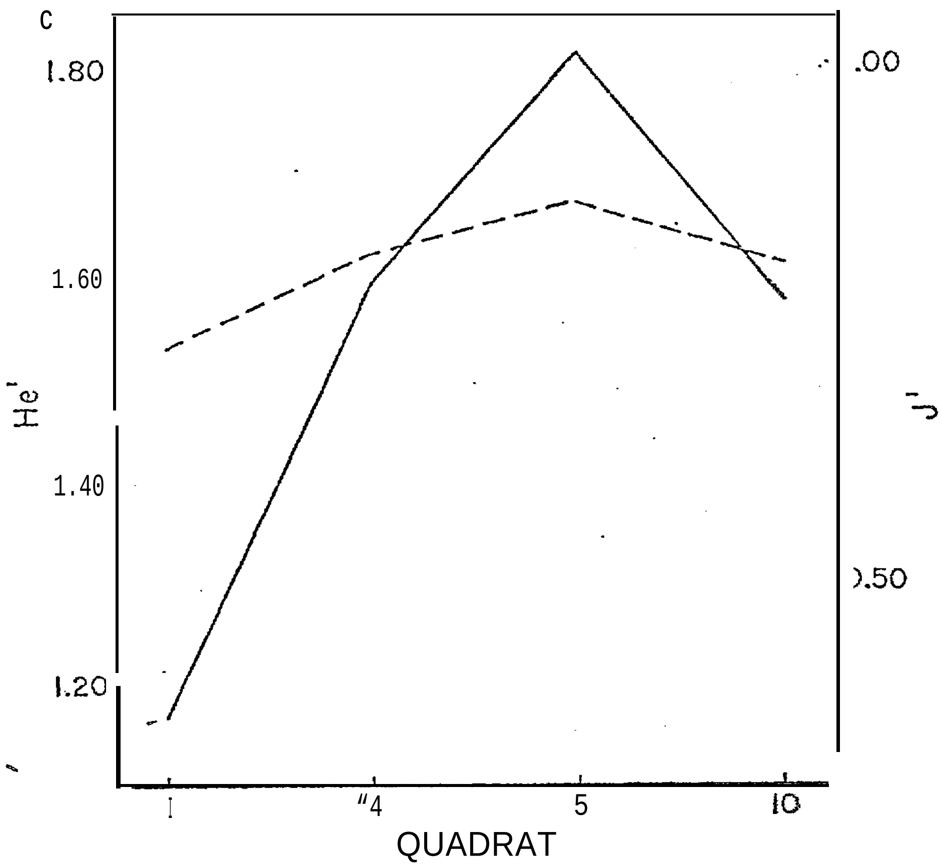
He" ______________ J '----------------

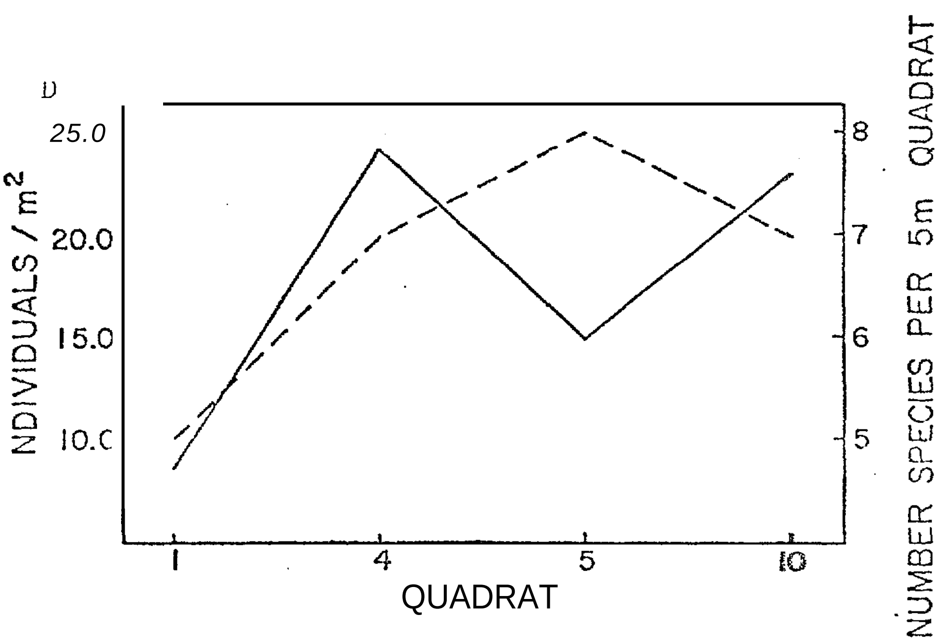
Figure 11B, 11D - Soft Coral Number of Individuals and Number of Species 5M Quadrat for BLM 19 and 32/34 Respectively at Station 047.

Individuals/M* _____________ No. Species/5M Quadrat -----------


A
1.20
-CD 1.10
H
1.00
1.00
).50
0.00
1
5
10
QUADRAT


B
INDIVIDUALS/m2
17.0
15.0
13.0
5
4
3
NUMBER SPECIES PER 5m QUADRAT
1
5
10
QUADRAT


C
1.80
1.60
1.40
1.20
He'
.00
).50
J'
I
"4
5
IO
QUADRAT


D
25.0
20.0
15.0
10.C
NDIVIDUALS / m²
8
7
6
5
NUMBER SPECIES PER 5m QUADRAT
I
4
5
IO
QUADRAT

B

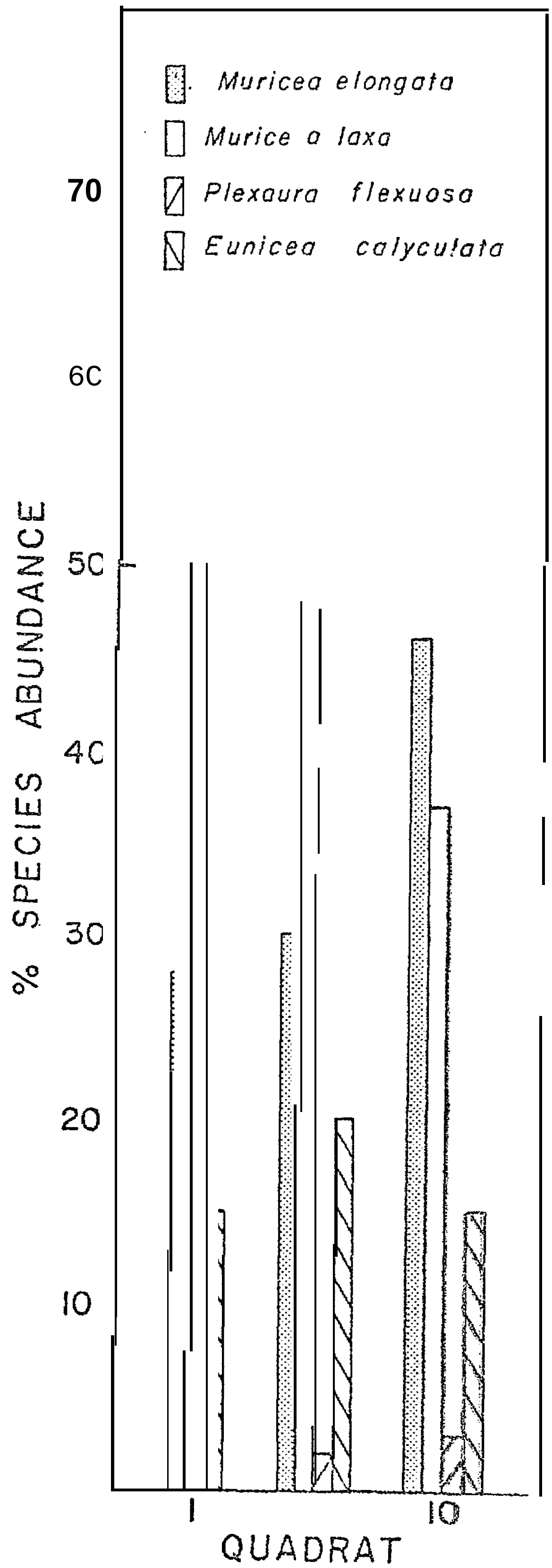


Figure 11E - Soft Cord Species Abundance, BLM 19 at Station 047.

3-0 7

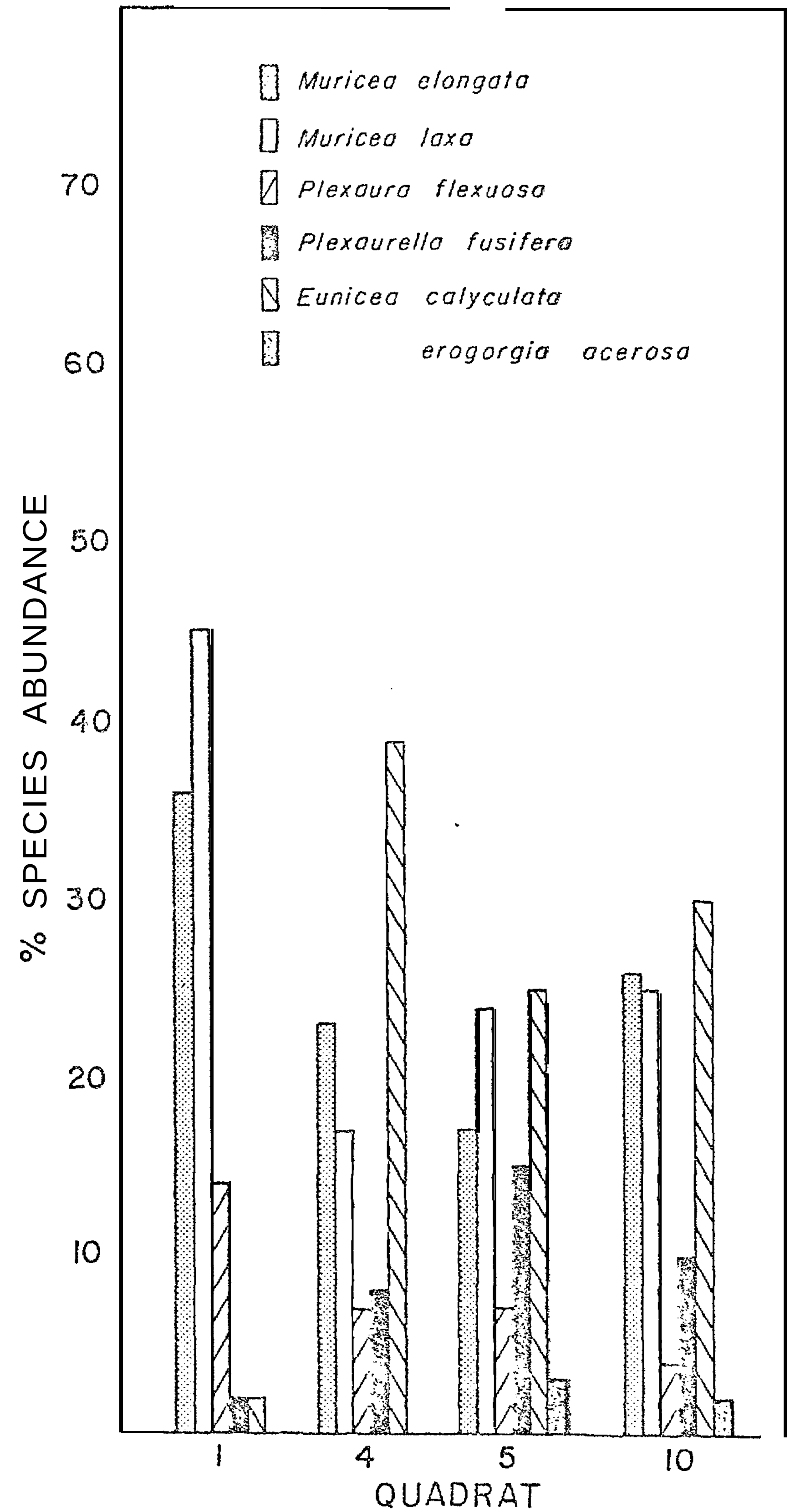


Figure 11F - Soft Coral Species Abundance, BLM 32/3! at Station 047.

B

D

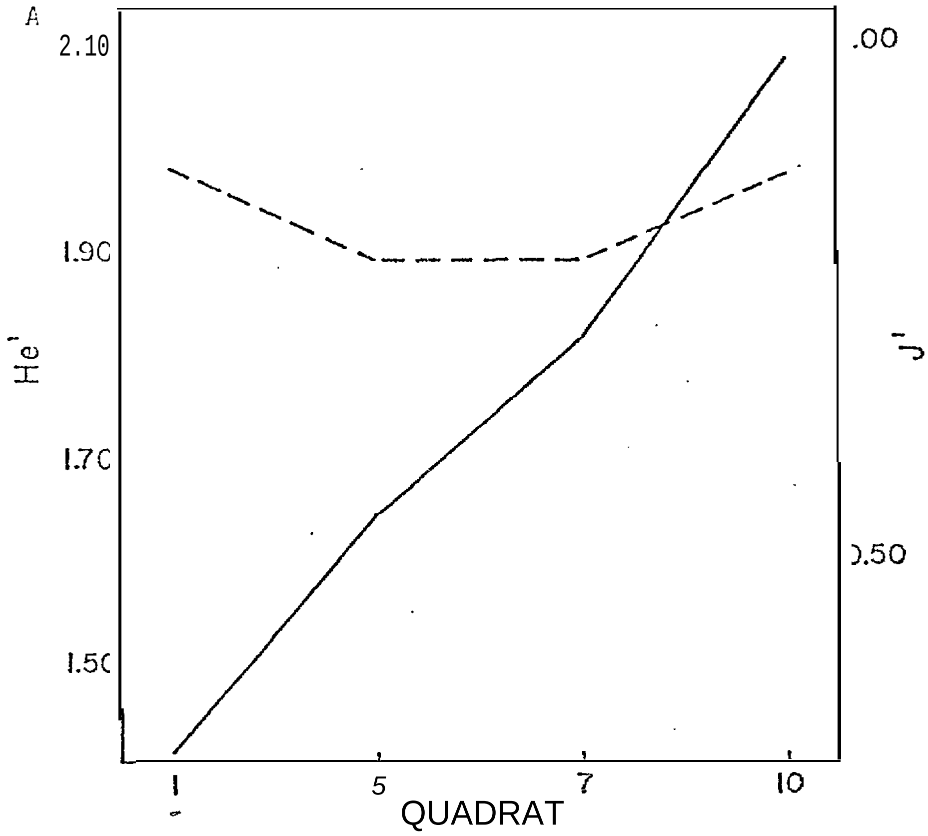
Figure 12 A,12C- Hard Coral Species Diversity and Evenness for BLM 19 and 32/34 Respectively at Station 151.

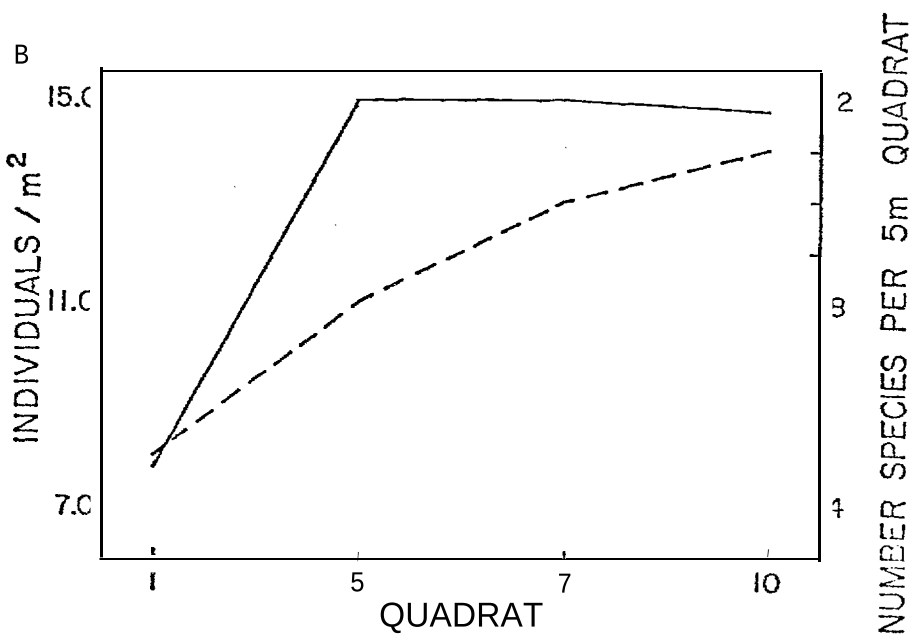
He'_ ________ J'----------

Figure 12B, 12D - Hard Coral Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 151.

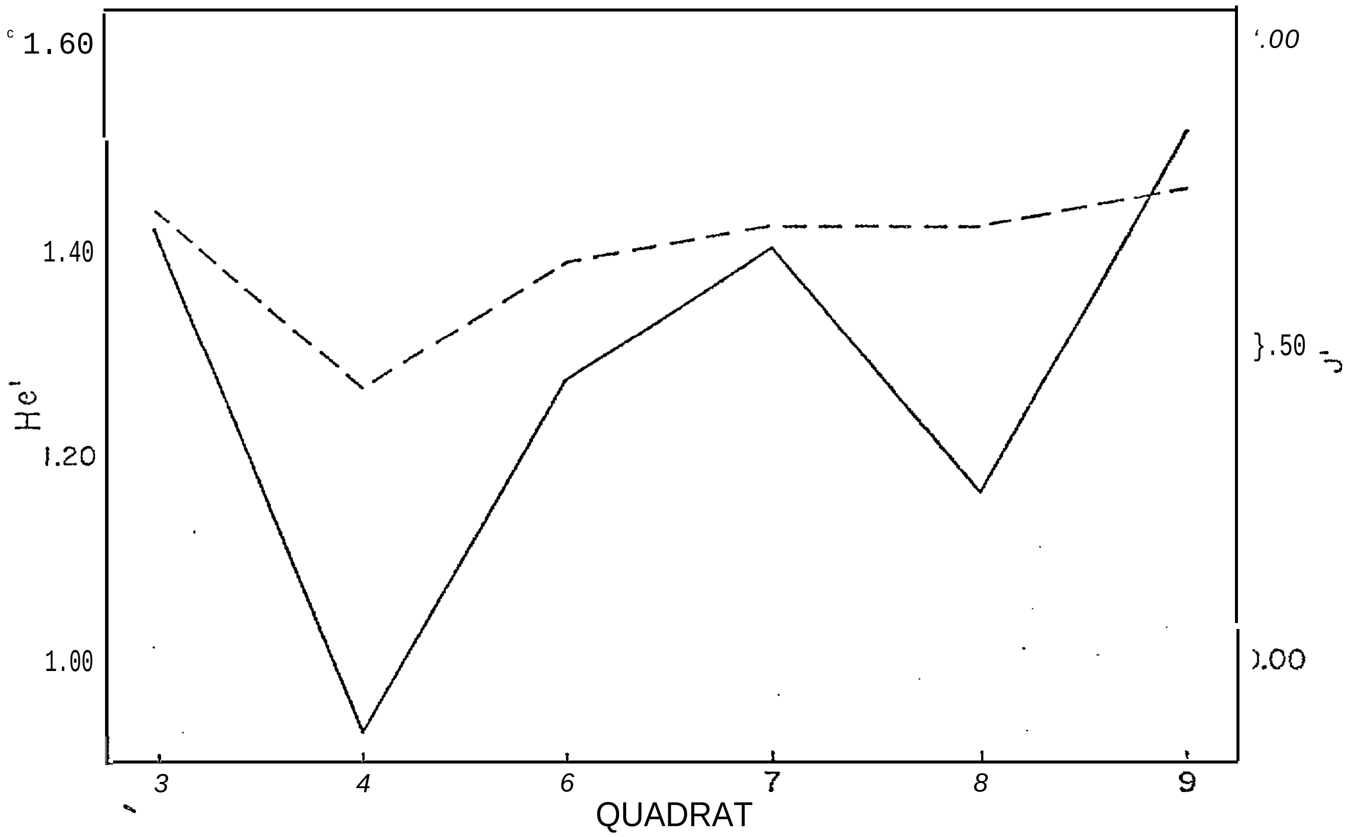
Individuals/M^2 _______ No. Species/5M Quadrat -----------

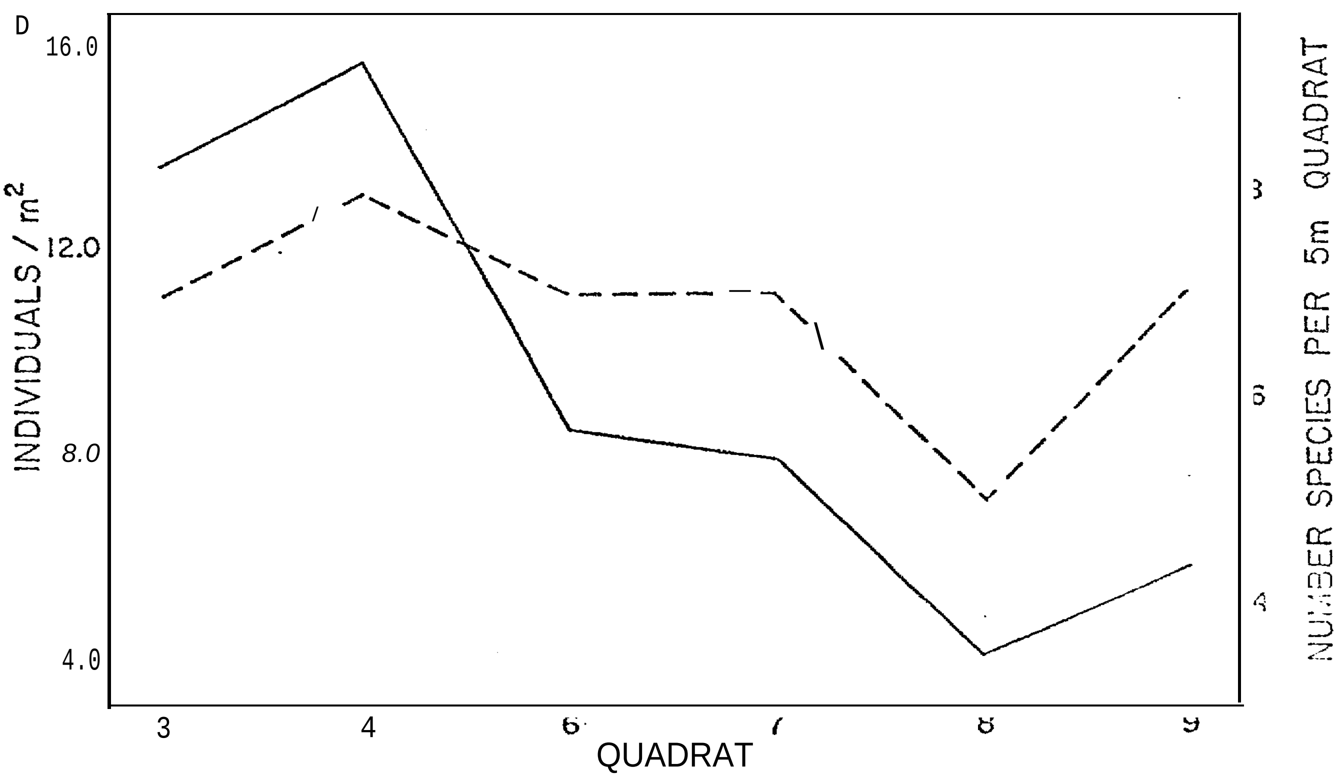
19-151 HC


A
2.10
1.90
1.70
1.50
He'
.00
0.50
J'
1
5
7
10
QUADRAT


B
15.0
11.0
7.0
INDIVIDUALS / m2
2
8
4
NUMBER SPECIES PER 5m QUADRAT
1
5
7
10
QUADRAT

32-15.1 HC


1.60
1.40
1.20
1.00
He'
.00
.50
J'
3
4
6
7
8
9
QUADRAT


D
16.0
12.0
8.0
4.0
INDIVIDUALS / m2
NUMBER SPECIES PER 5m QUADRAT
3
4
8
9
QUADRAT

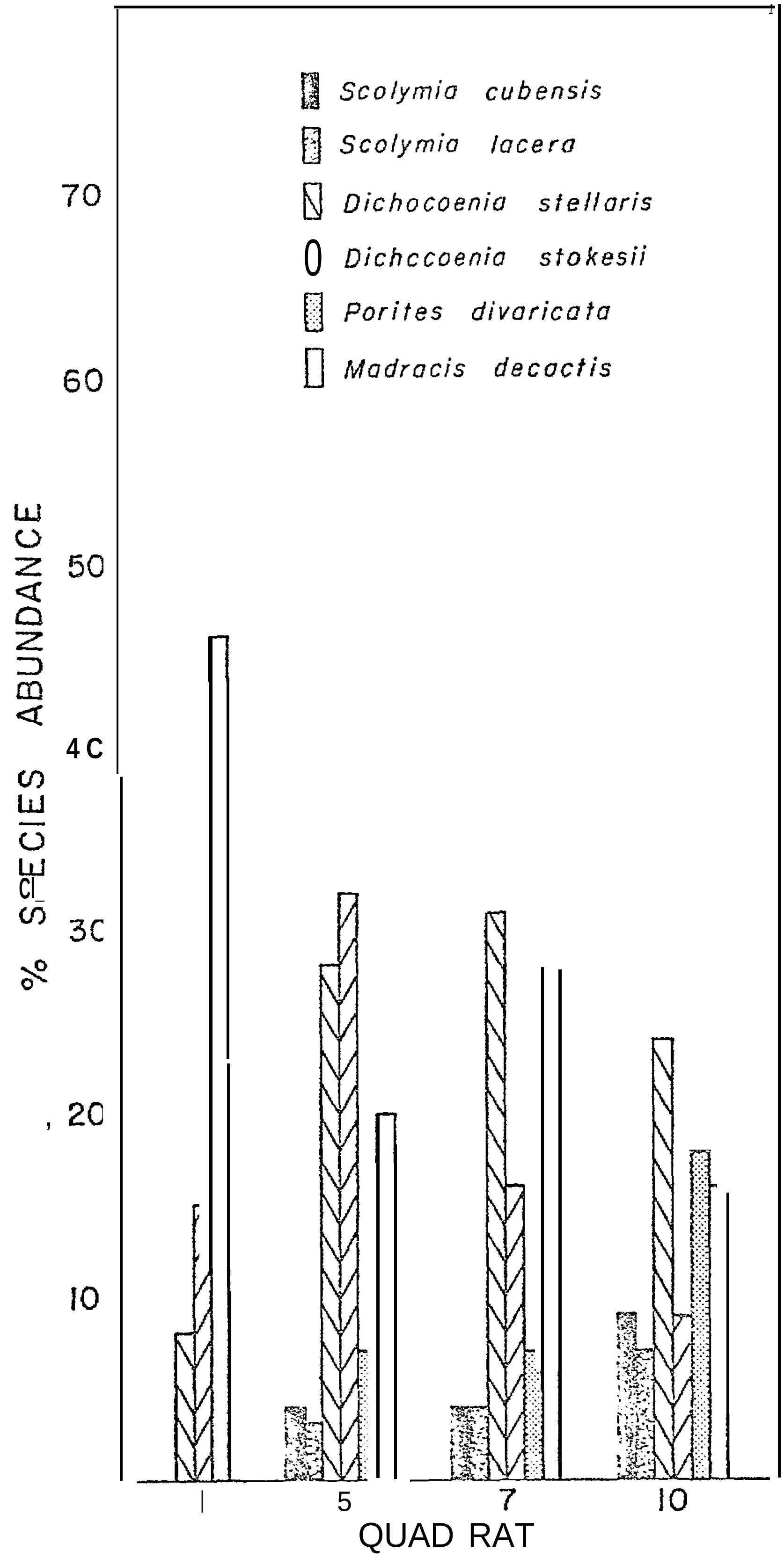


Figure 12E - Hard Coral Species Abundance, BLM 19 at Station 151.

P

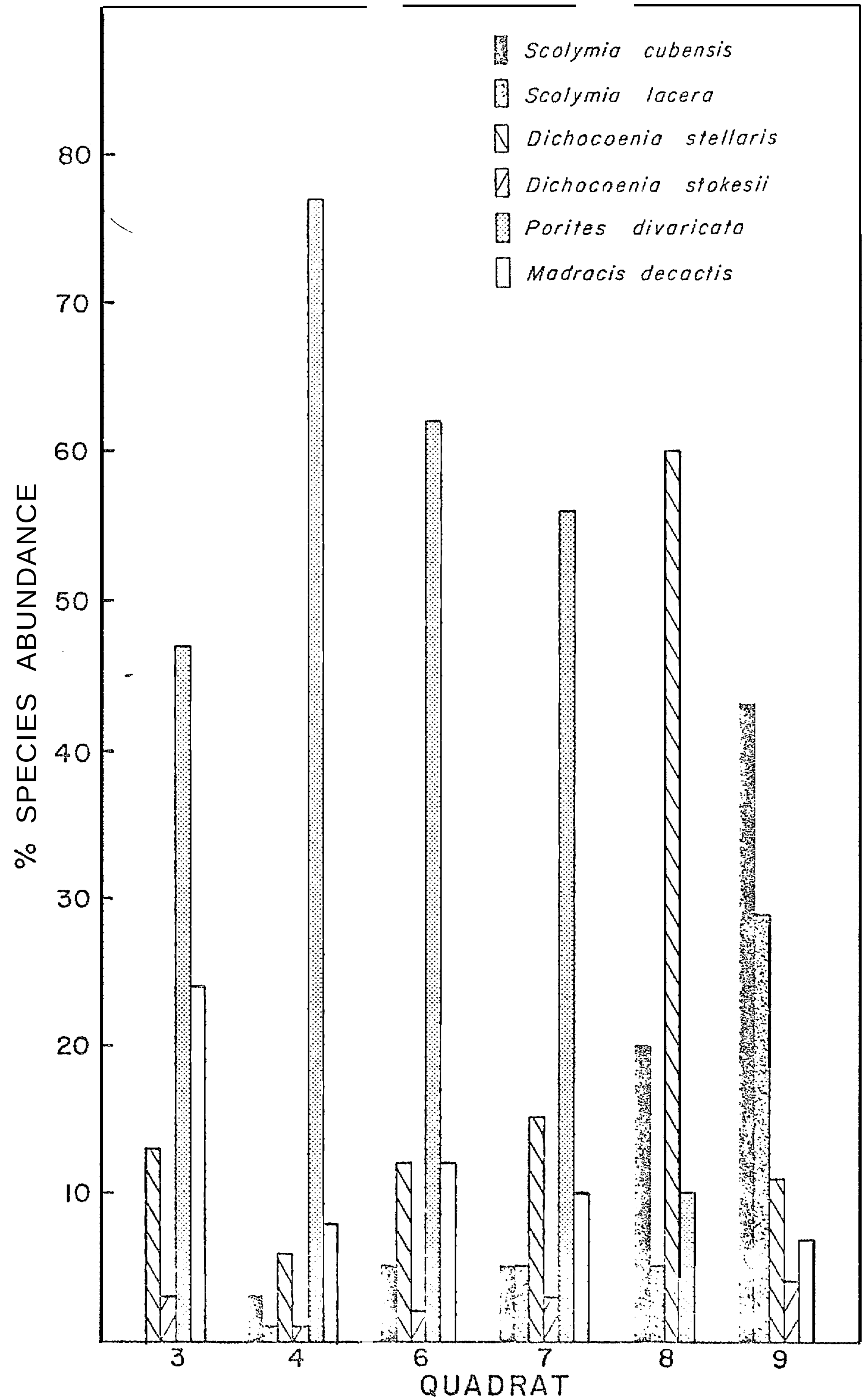


Figure 12F- Hard Coral Species Abundance, BLM 32/34 at Station 151.

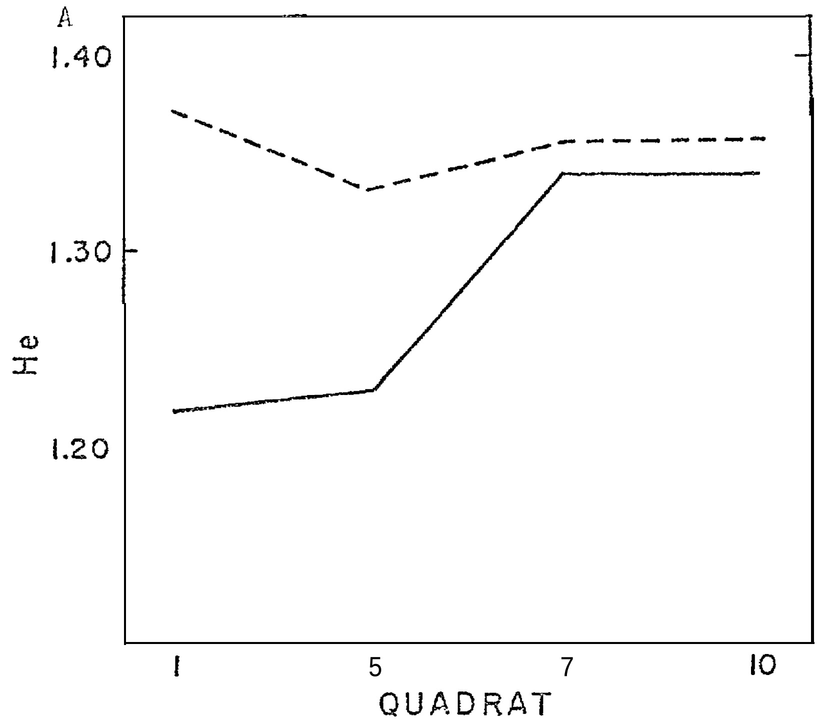
Figure 13B, 13D - Soft Coral Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 151.

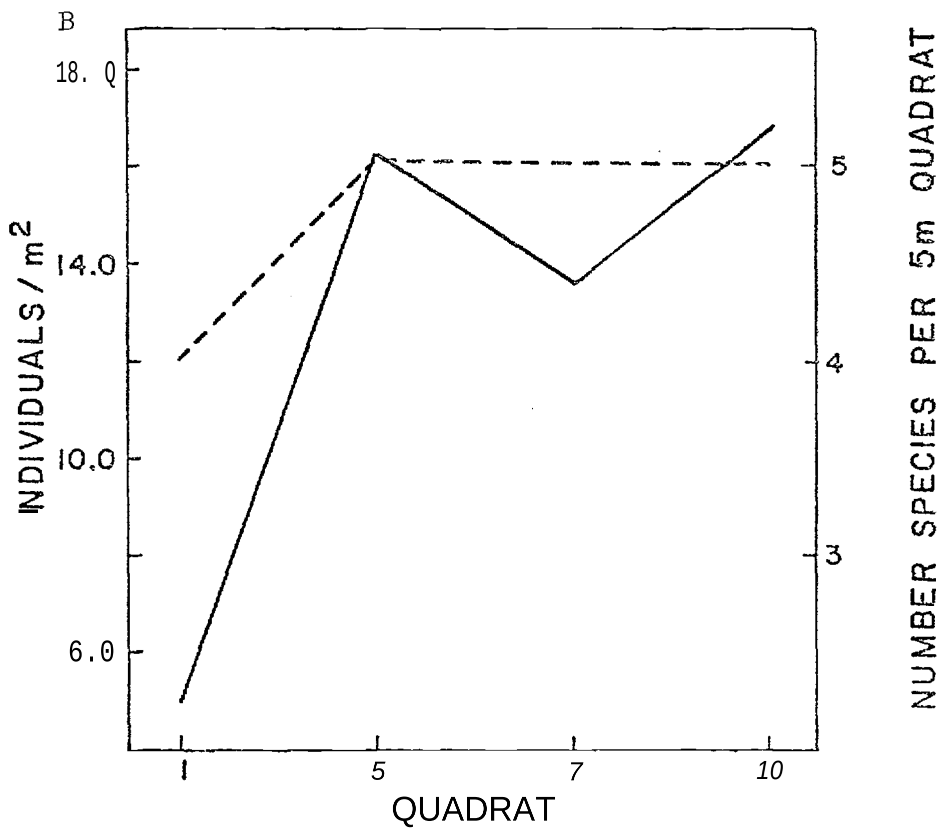
Individuals/M^2 ____________ No. Species/5M Quadrat -----------

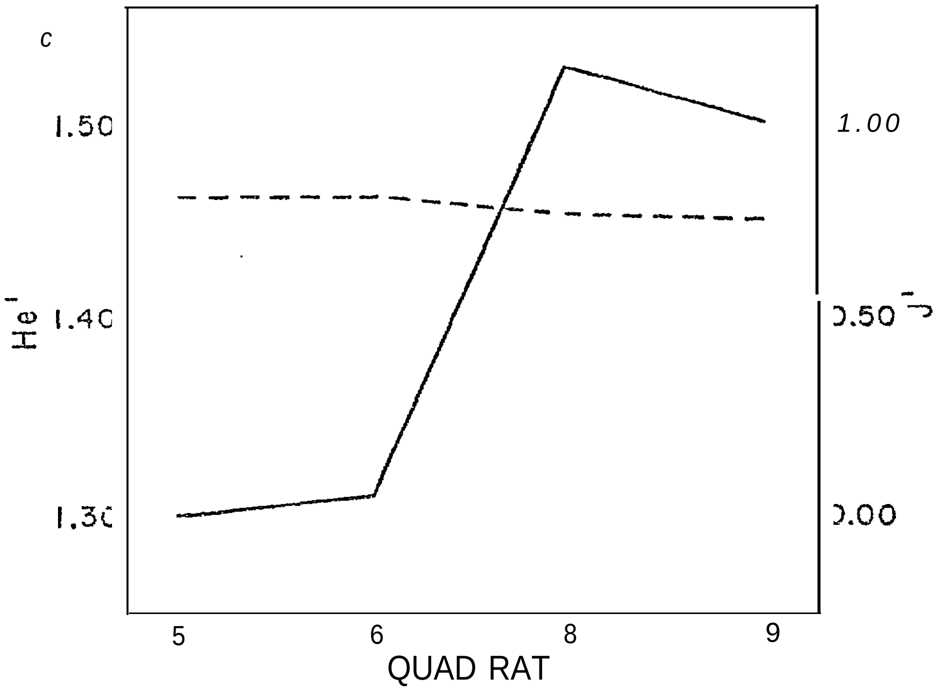
Figure 13A, 13C - Soft Coral Species Diversity and Evenness for BLM 19 and 32/34 Respectively at Station 151.

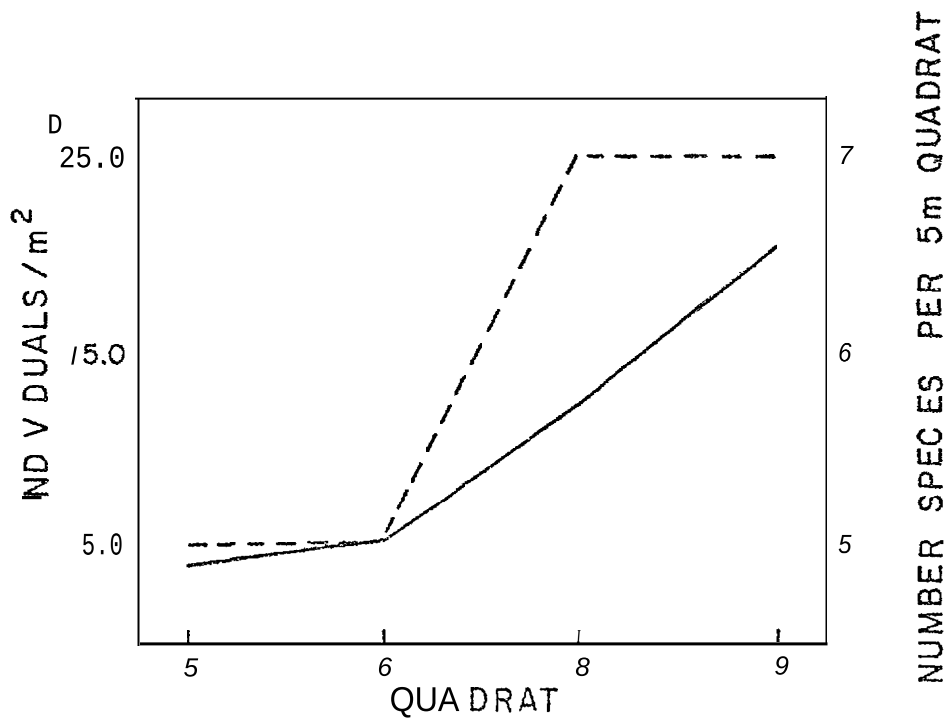
He' _____________ J' ---------------

19-151 se


A
1.40
1.30
1.20
He
1
5
7
10
QUADRAT


B
18. Q
14.0
10.0
6.0
INDIVIDUALS / m2
5
4
3
NUMBER SPECIES PER 5m QUADRAT
1
5
7
10
QUADRAT


C
1.50
1.40
1.30
He'
1.00
0.50
0.00
J'
5
6
8
9
QUAD RAT


D
25.0
15.0
5.0
ND V DUALS / m^2
7
6
5
NUMBER SPEC ES PER 5m QUADRAT
5
6
8
9
QUA DRAT

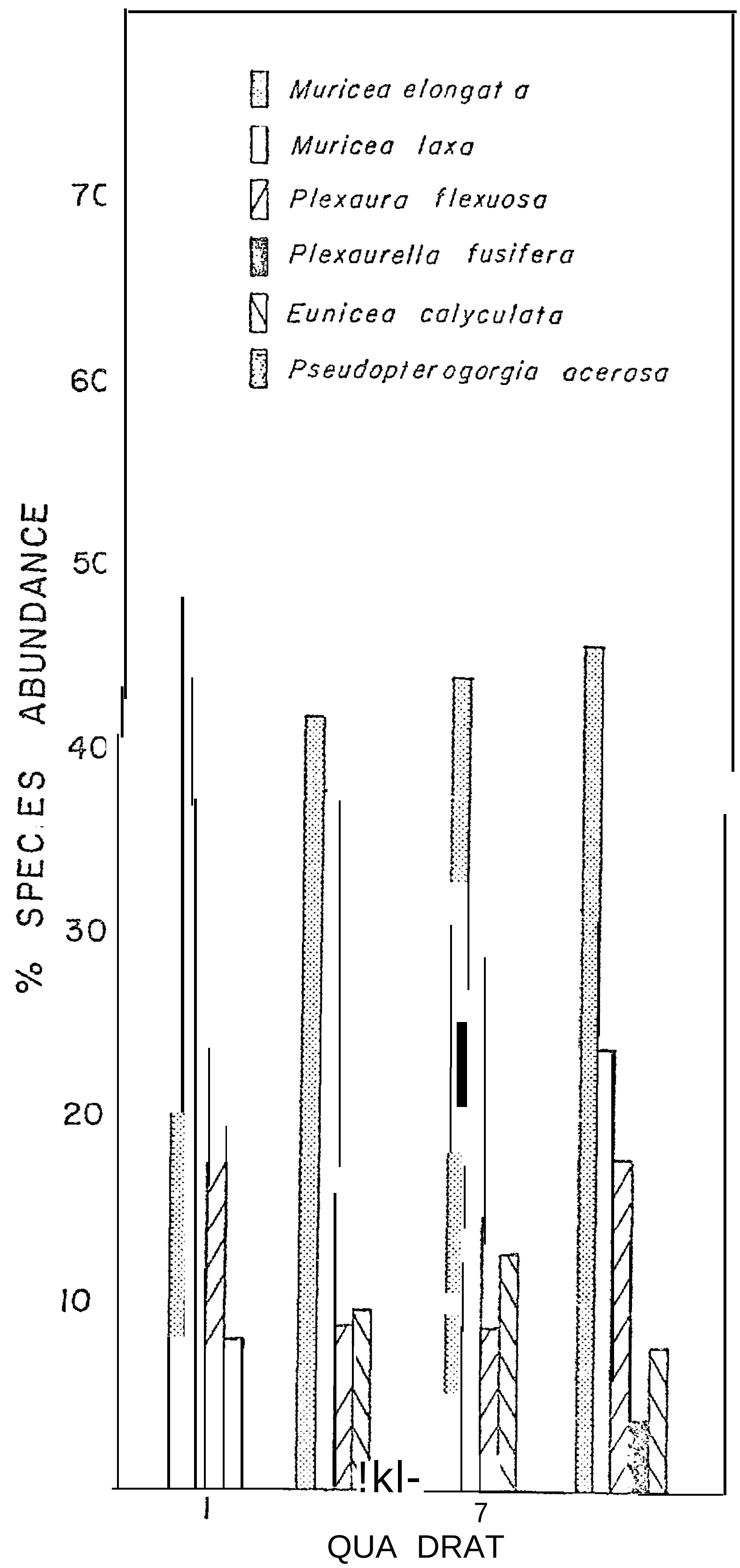


Figure 13E - Soft Coral Species Abundance, BLM 19 at Station 151.

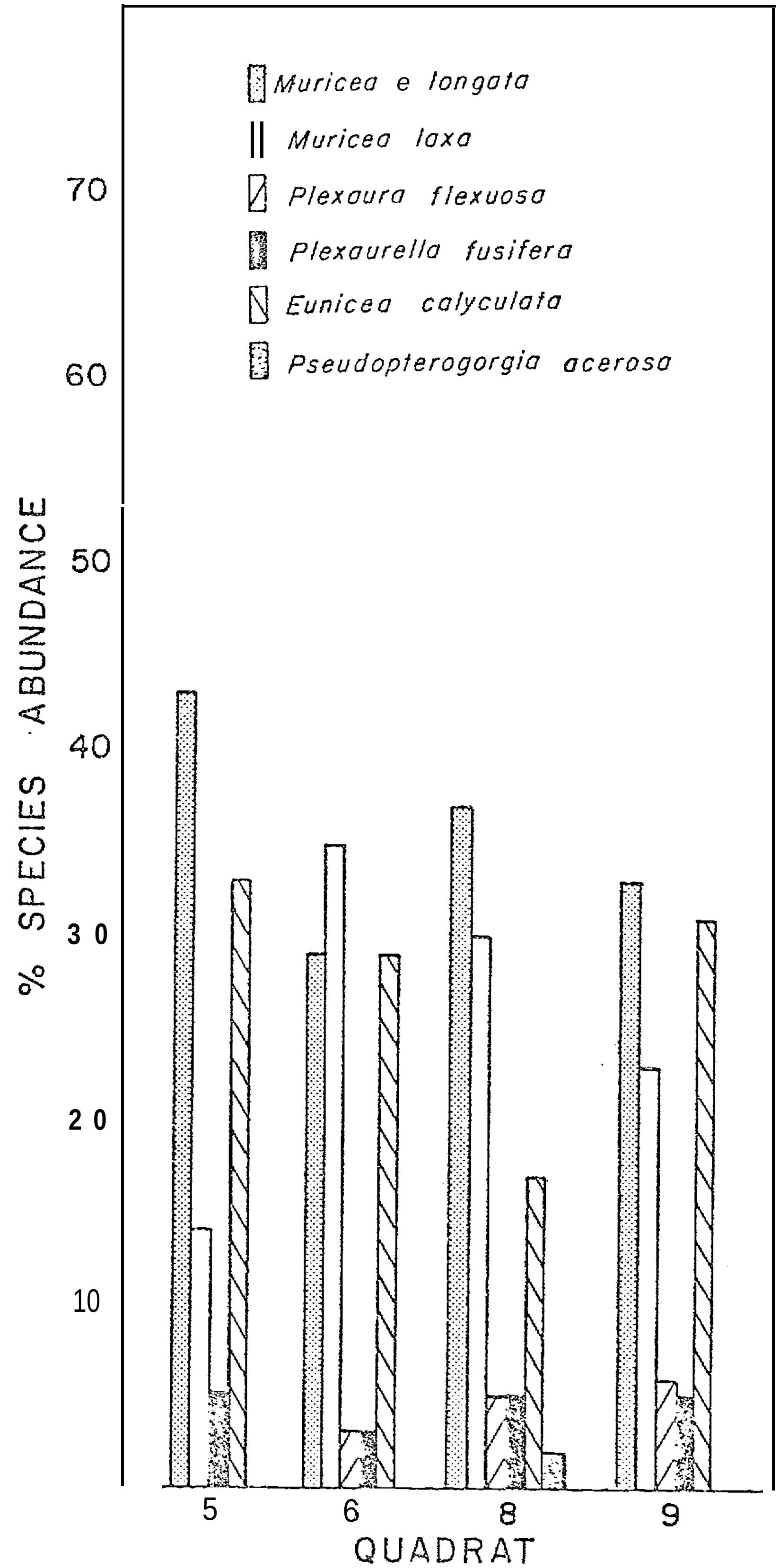


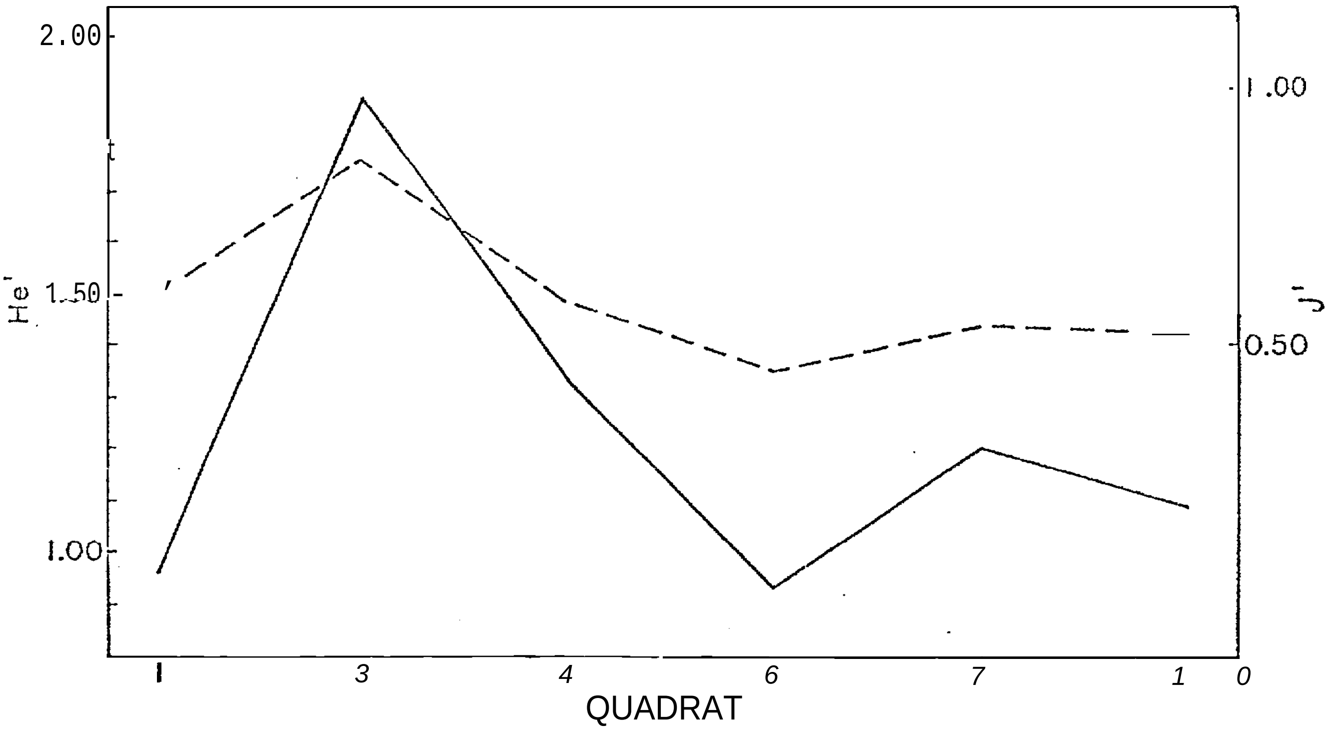
Figure 13F - Soft Coral Species Abundance, BLM 32/34 at Station 151.

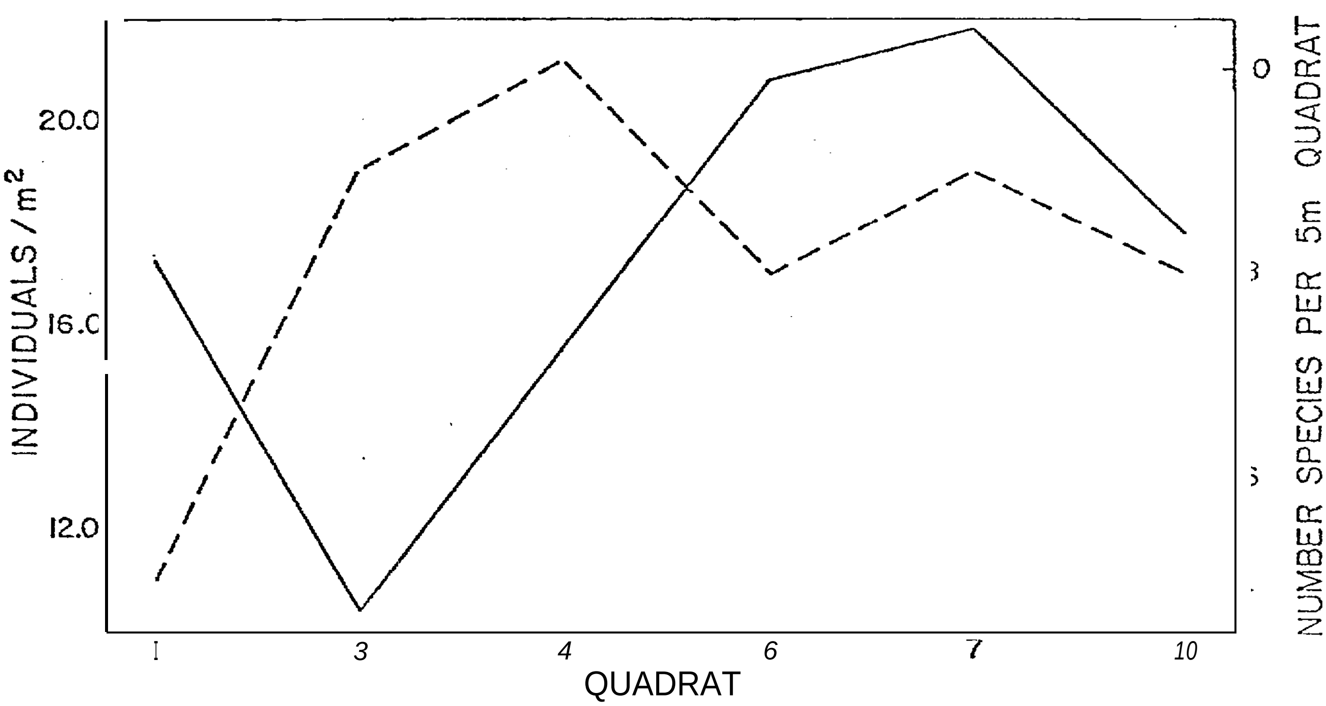
Figure 14 A,14C- Hard Coral Species Diversity and Evenness for BLM 19 and 32/34 Respectively at Station 251.

He '__________ J ' ----------

Figure 14B, 14D - Hard Coral Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 251.

Individuals/M^2 ________ No. Species/5M Quadrat ----- -----


2.00
1.50
1.00
He'
1.00
0.50
J'
I
3
4
6
7
1
0
QUADRAT


20.0
16.0
12.0
INDIVIDUALS / m²
NUMBER SPECIES PER 5m QUADRAT
I
3
4
6
7
10
QUADRAT

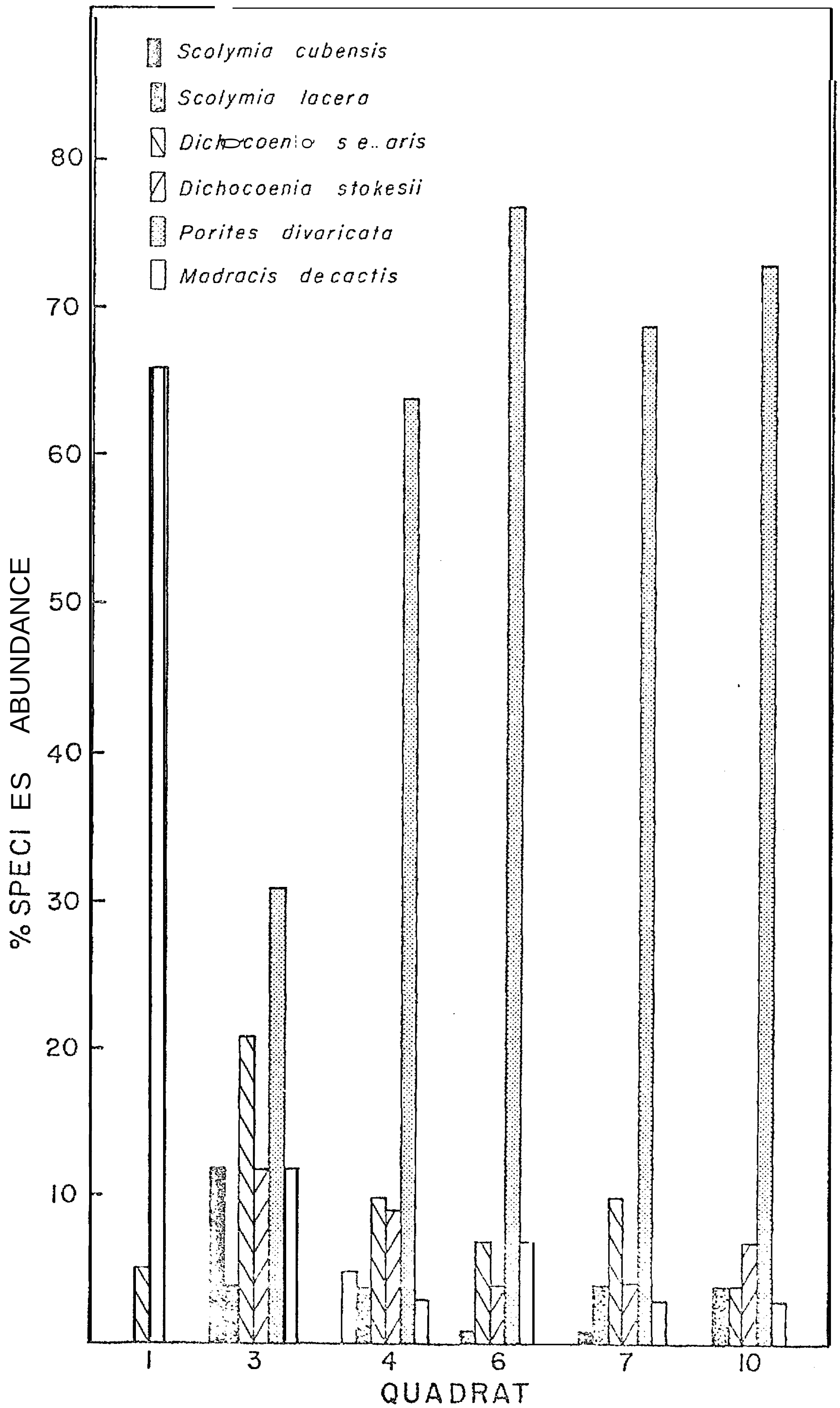


Figure 14E - Hard Coral Species Abundance, BLM 19

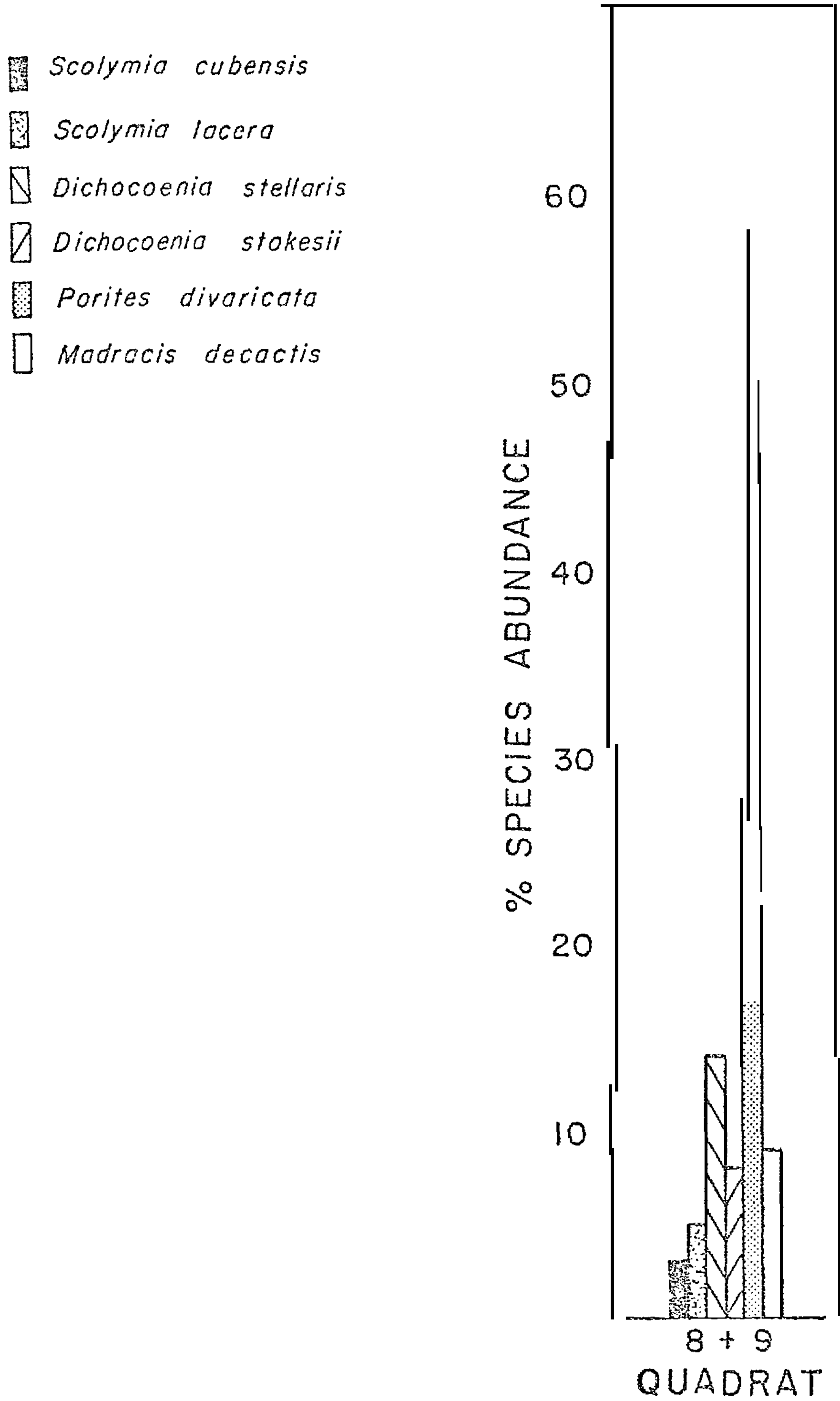


Figure 14F - Hard Coral Species, BLM-34
at Station 251.

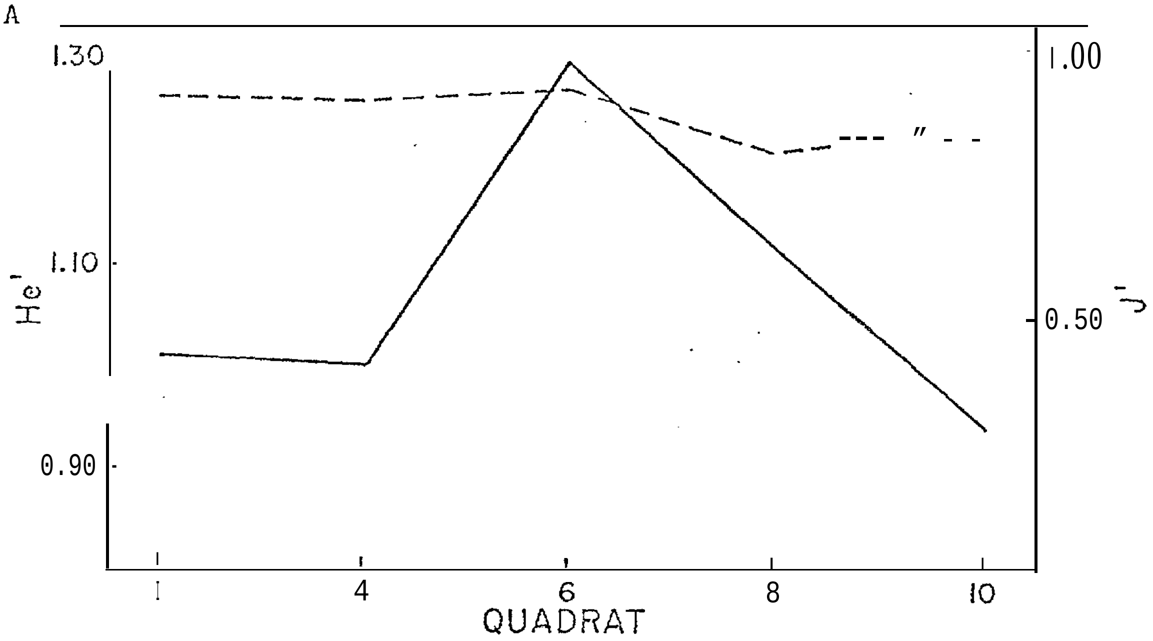
Figure 15A, 15C - Soft Coral Species Divers it y and Evenness for BLM 19 and 32/34 Respectively at Station 251.

He' ______________ J' - - - - - - - - - - - - - -

Figure 15B, 15D - Soft Coral Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 251.

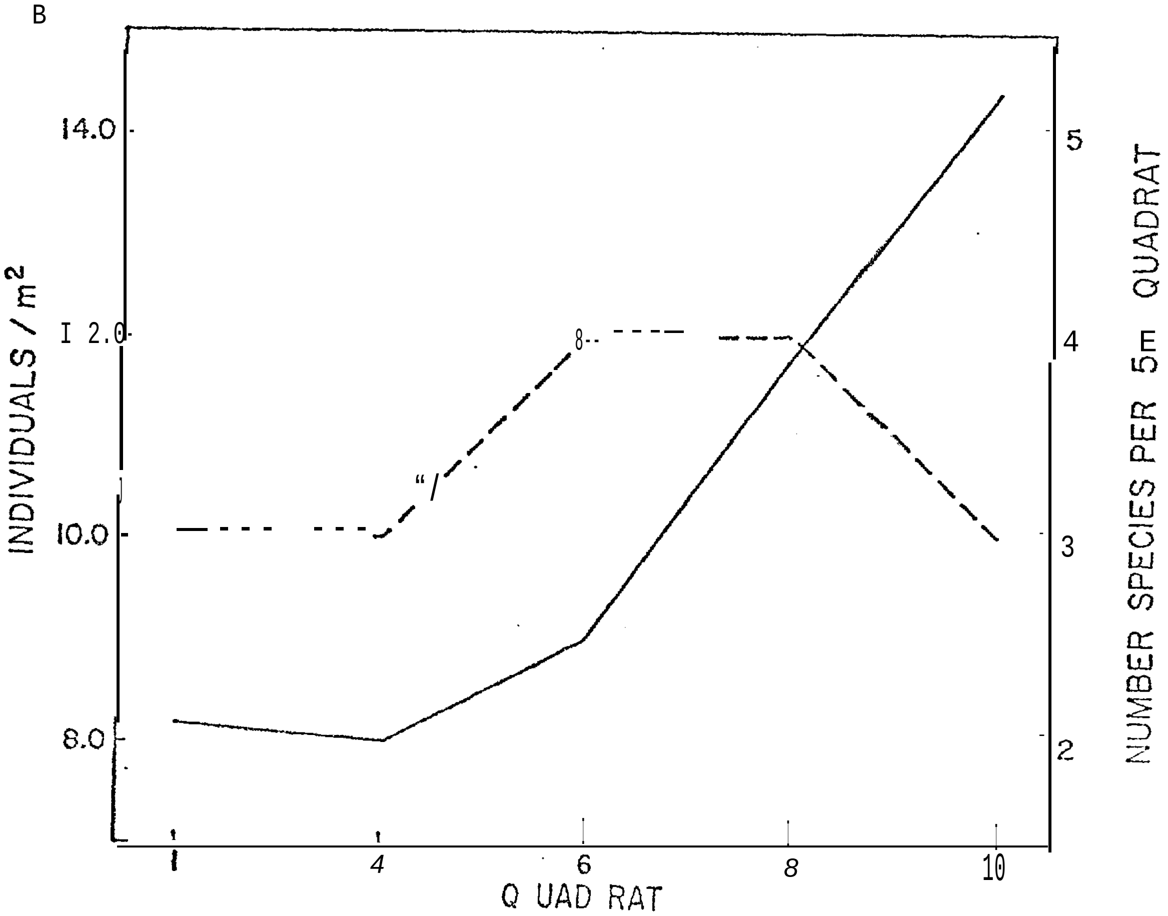
Individuals/M^2 ______________ No. Species/5M Quadrat - - - - - - - - - - - -

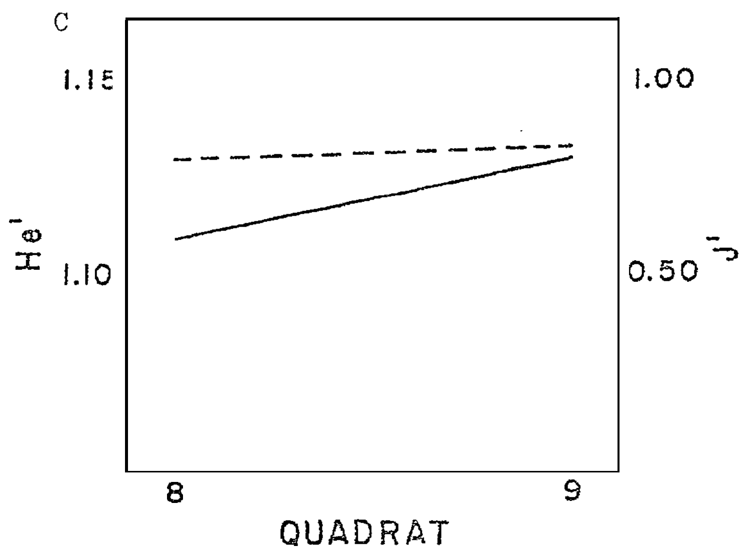
A

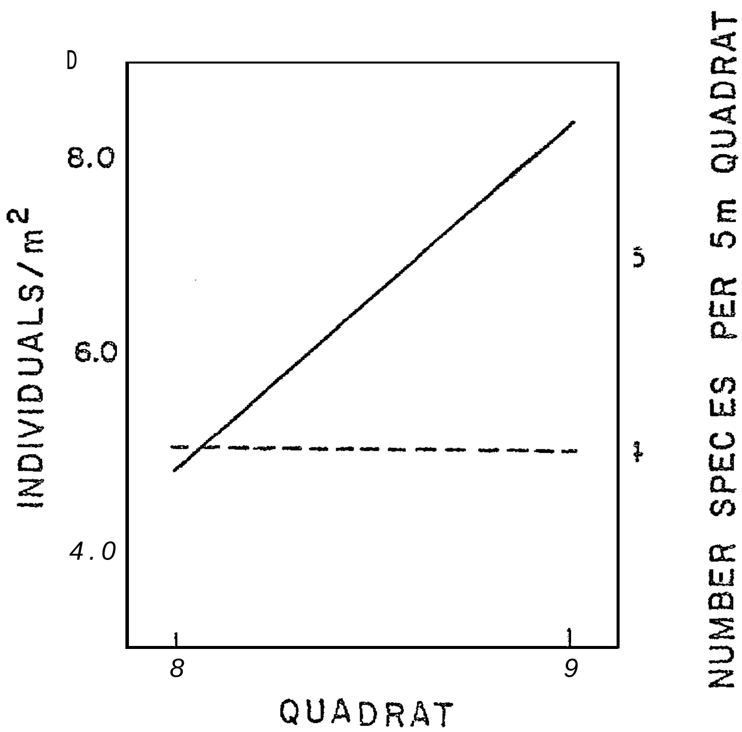

1.30
1.10
0.90
He'
1.00
0.50
J'
I
4
6
8
10
QUADRAT

B

B


14.0
I 2.0
10.0
8.0
INDIVIDUALS / m²
5
4
3
2
NUMBER SPECIES PER 5m QUADRAT
I
4
6
8
10
Q UAD RAT


C
1.15
1.10
He'
1.00
0.50
J'
8
9
QUADRAT


D
8.0
6.0
4.0
INDIVIDUALS/m2
5
4
NUMBER SPECIES PER 5m QUADRAT
8
9
QUADRAT

P

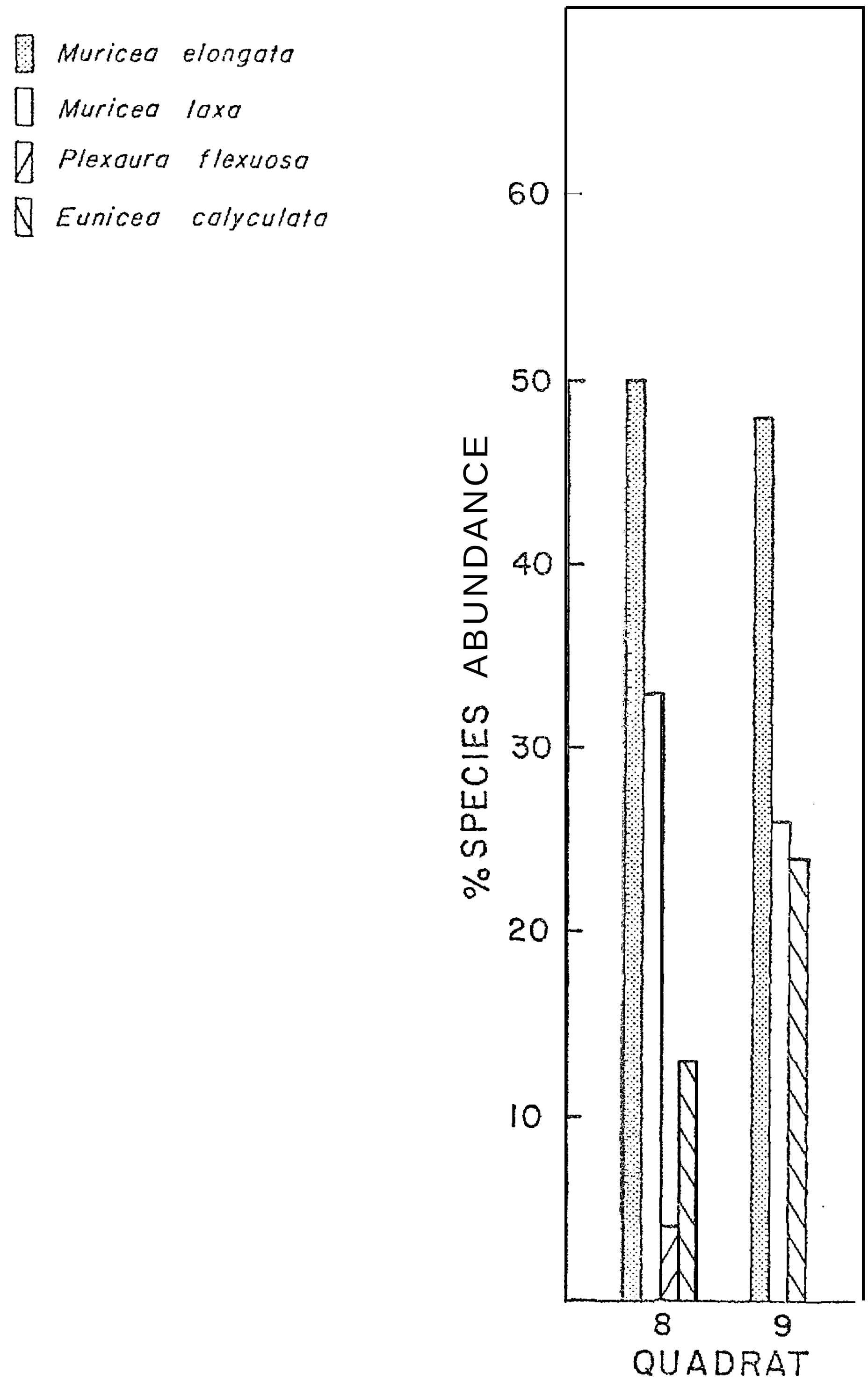


Figure 15F- Soft Coral Species Abundance, BLM 32 W at Station 251.

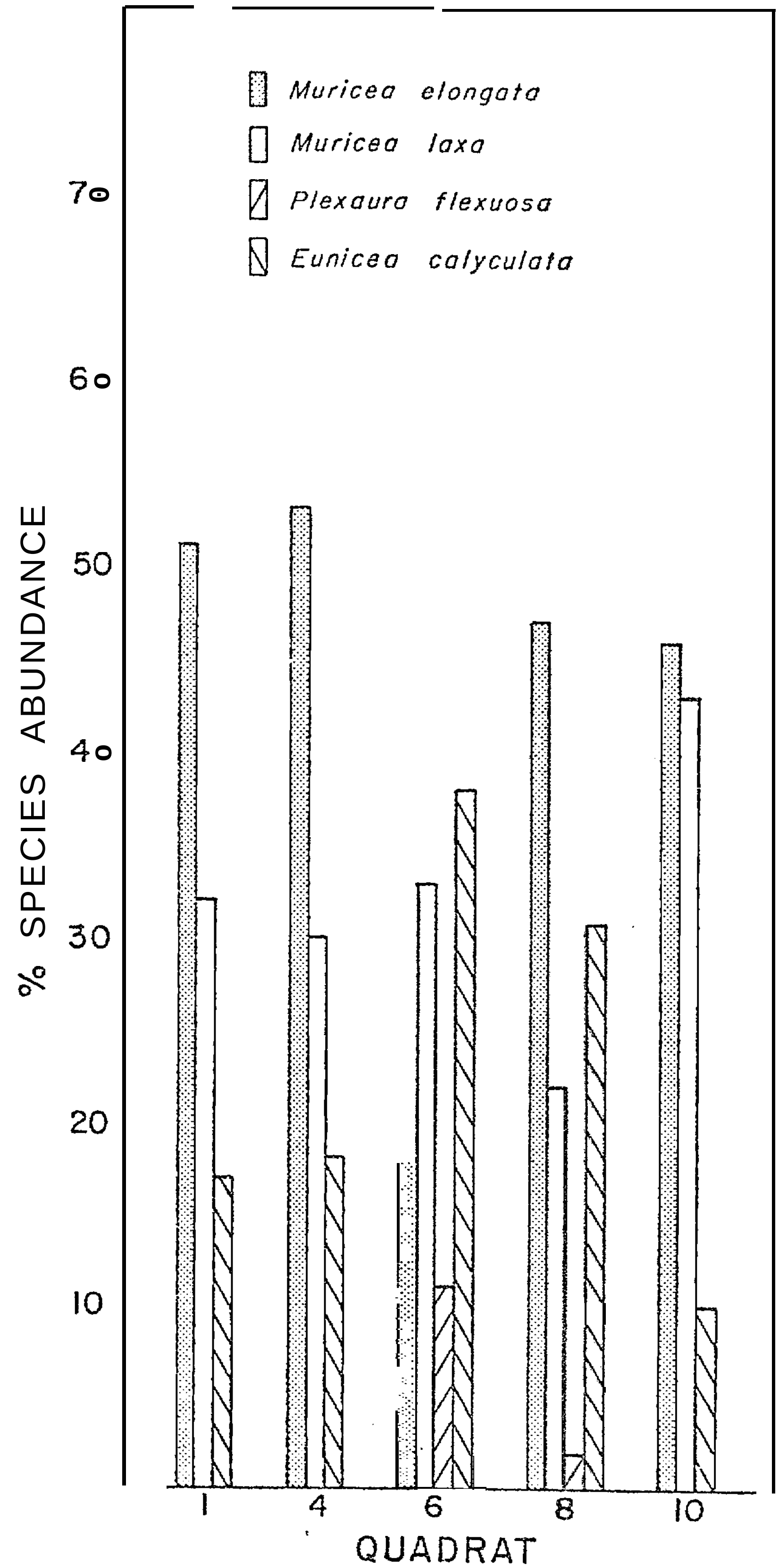


Figure 15E - Soft Coral Species Abundance, BLM 19 at Station 251.

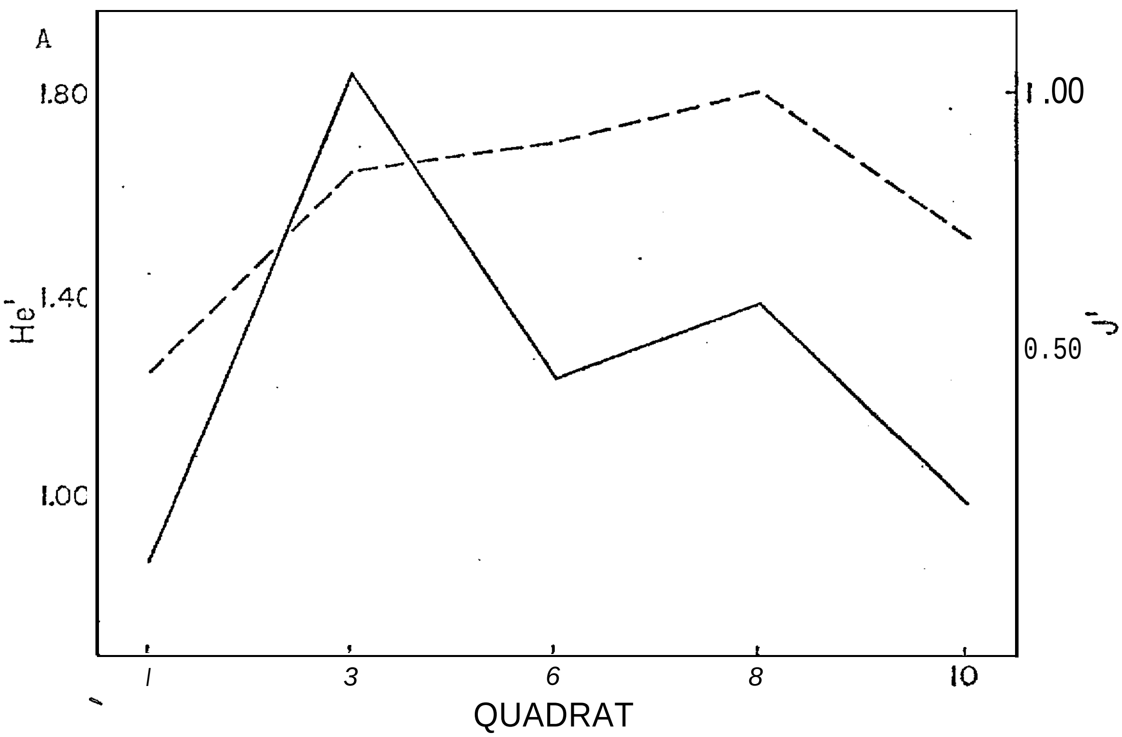
Figure 16A,16C- Hard Coral Species DiversSty and Evenness for BLM 19 and 32/34 Respectively at Station 247.

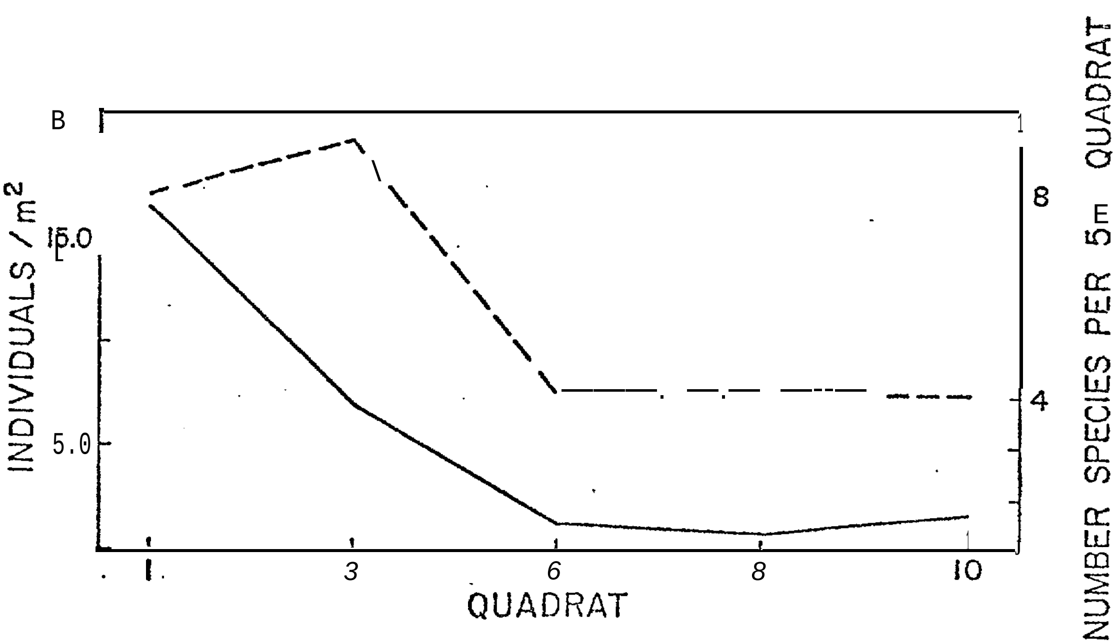
He'_ ________ J~-----__---

Figure 16B, 16D - Hard Coral Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 247.

Individuals/M^2 ____________ No. Species/5M Quadrat ------------

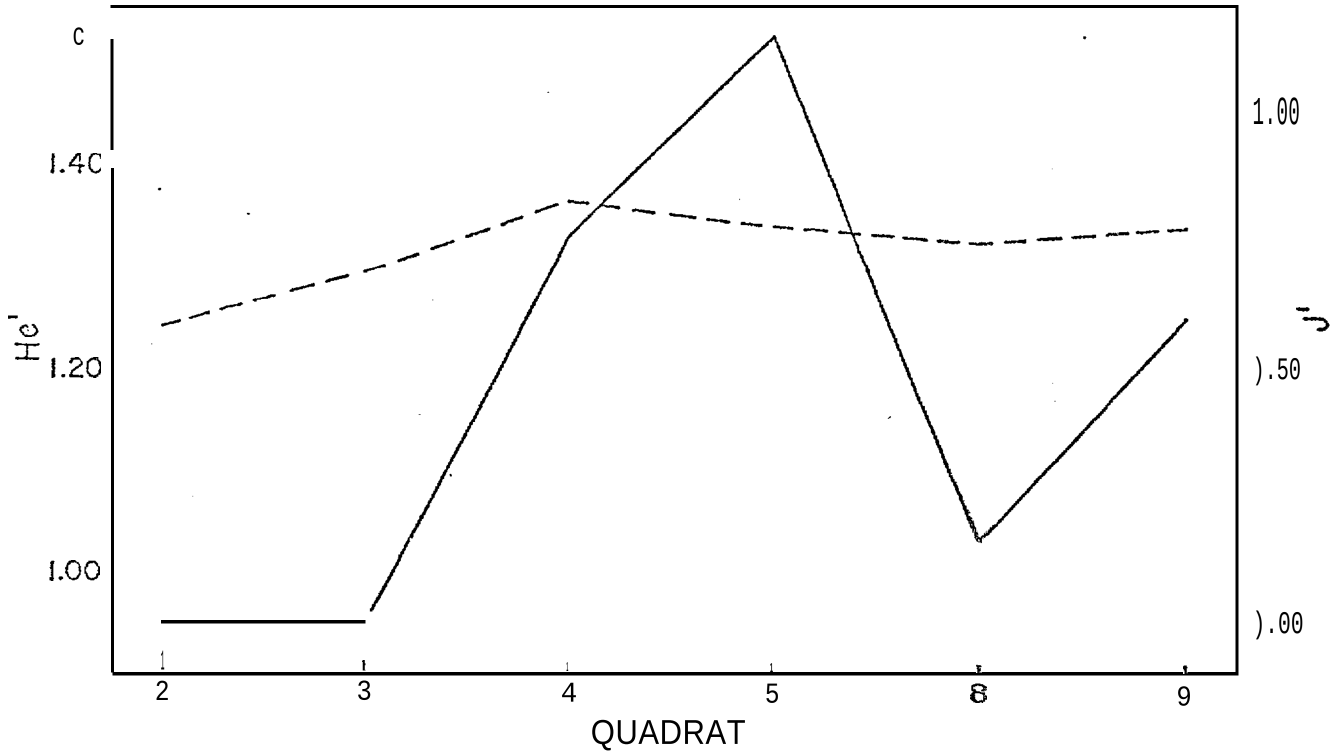
19-247 HC

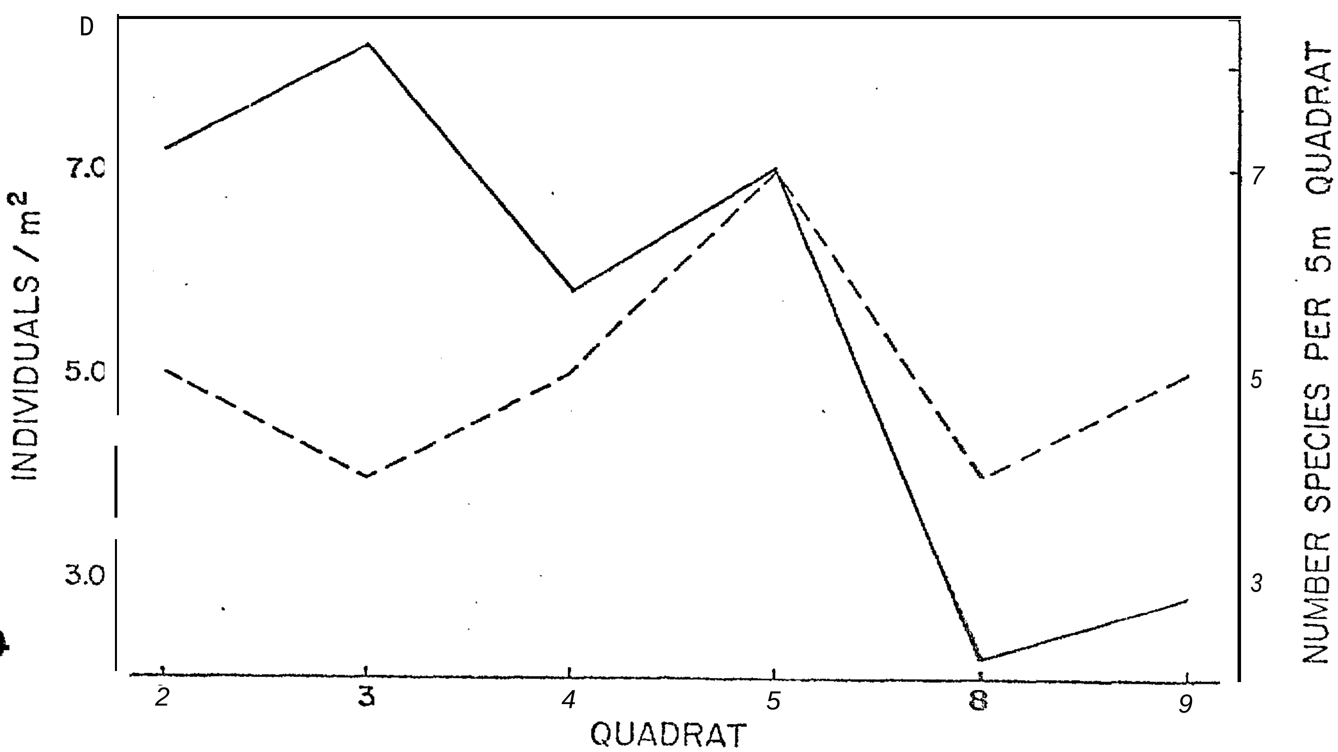

A
1.80
1.40
1.00
He'
1.00
0.50
J'
1
3
6
8
10
QUADRAT


B
15.0
5.0
INDIVIDUALS / m2
8
4
NUMBER SPECIES PER 5m QUADRAT
1
3
6
8
10
QUADRAT

32-247 HC

B


C
1.40
1.20
1.00
He'
1.00
).50
).00
J'
2
3
4
5
8
9
QUADRAT


D
7.0
5.0
3.0
INDIVIDUALS / m²
7
5
3
NUMBER SPECIES PER 5m QUADRAT
2
3
4
5
8
9
QUADRAT

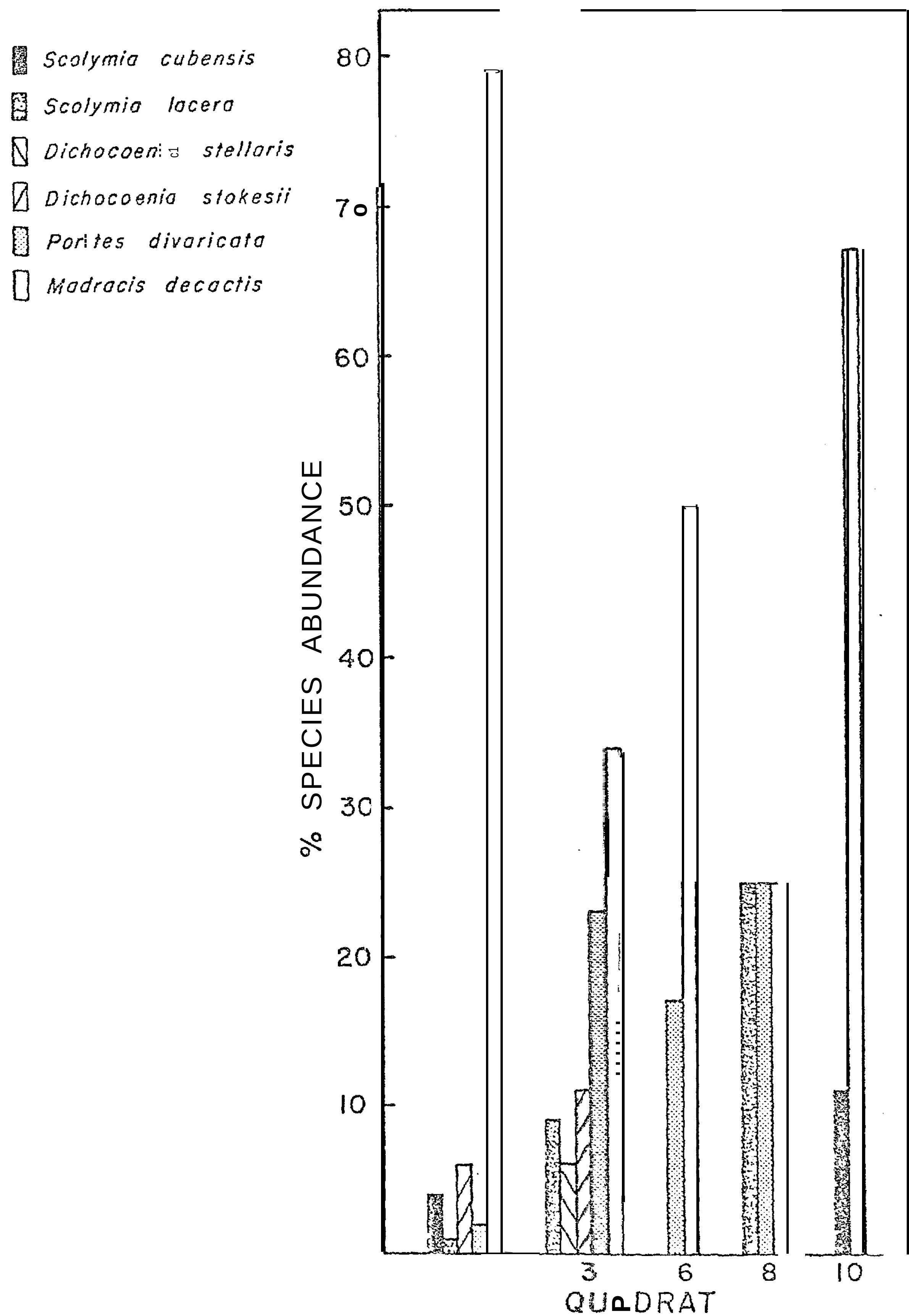


Figure 16E - Hard Coral ies Abundance, BLM 19 at Station 247.

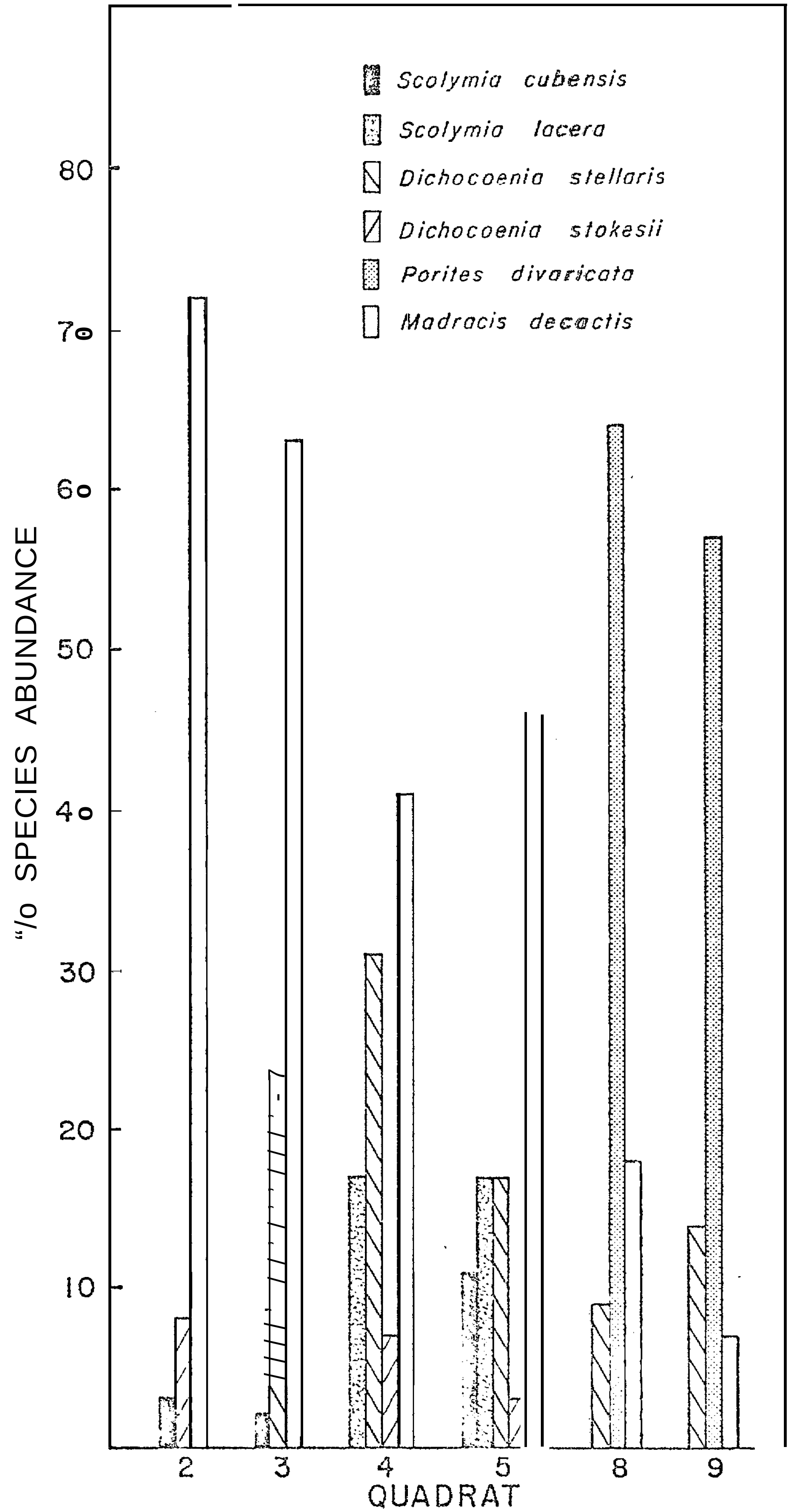


Figure 16F- Hard Coral Species Abundance, BLM 32/34 at Station 247

B

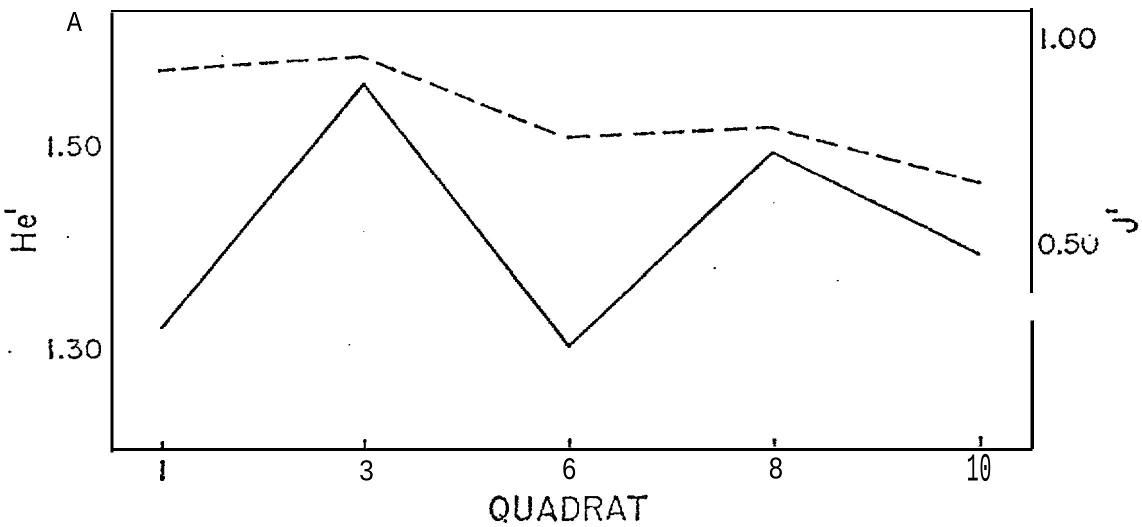
Figure 17A, 17C - Soft Coral. Species Diversity and Evenness for BLM 19 and 32/34 Respectively at Station 247.

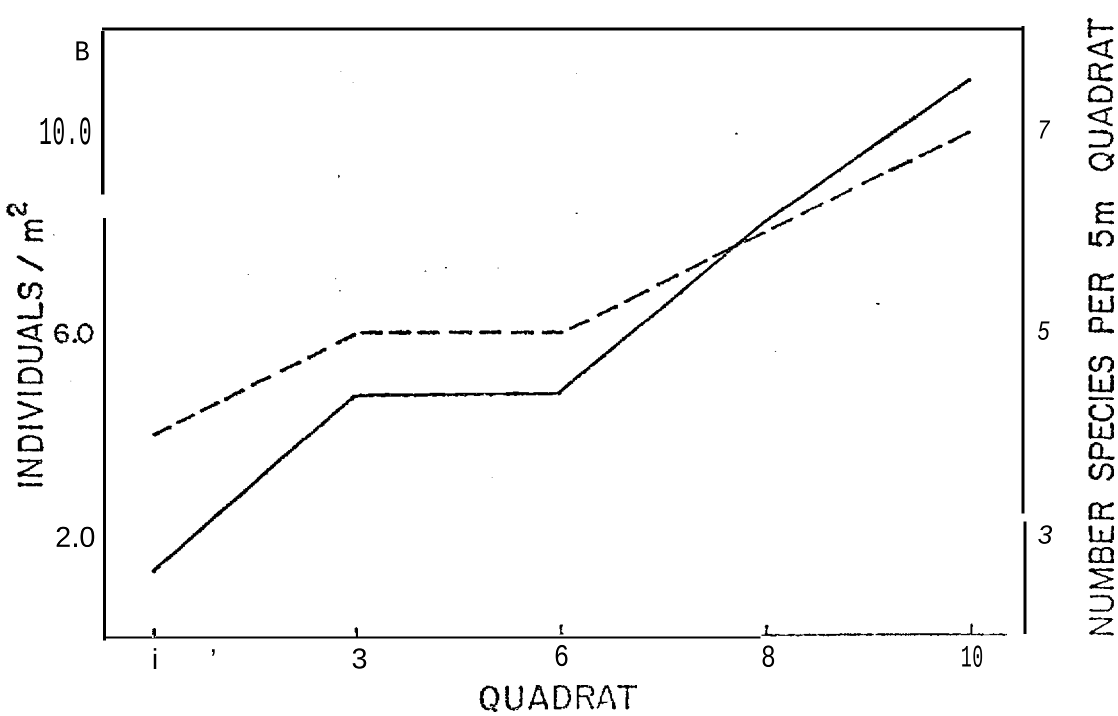
He' ________________ J' ----------------

Figure 17B, 17D - Soft Coral Number of Individuals and Number of Species/5M Quadrat for BLM 19 and 32/34 Respectively at Station 247.

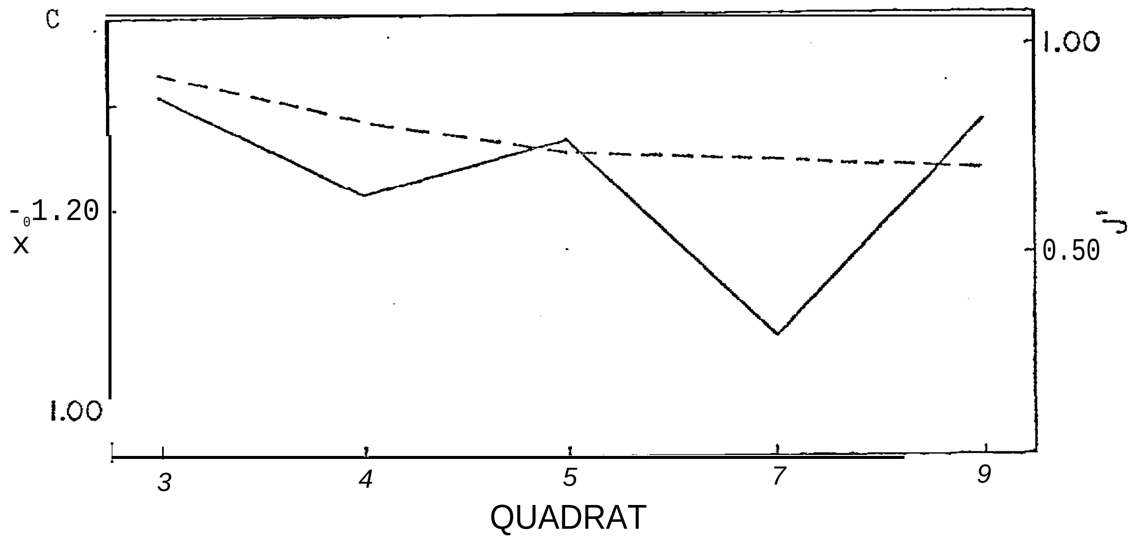
Individuals/M^2 ____________ No. Species/5M Quadrat ------------

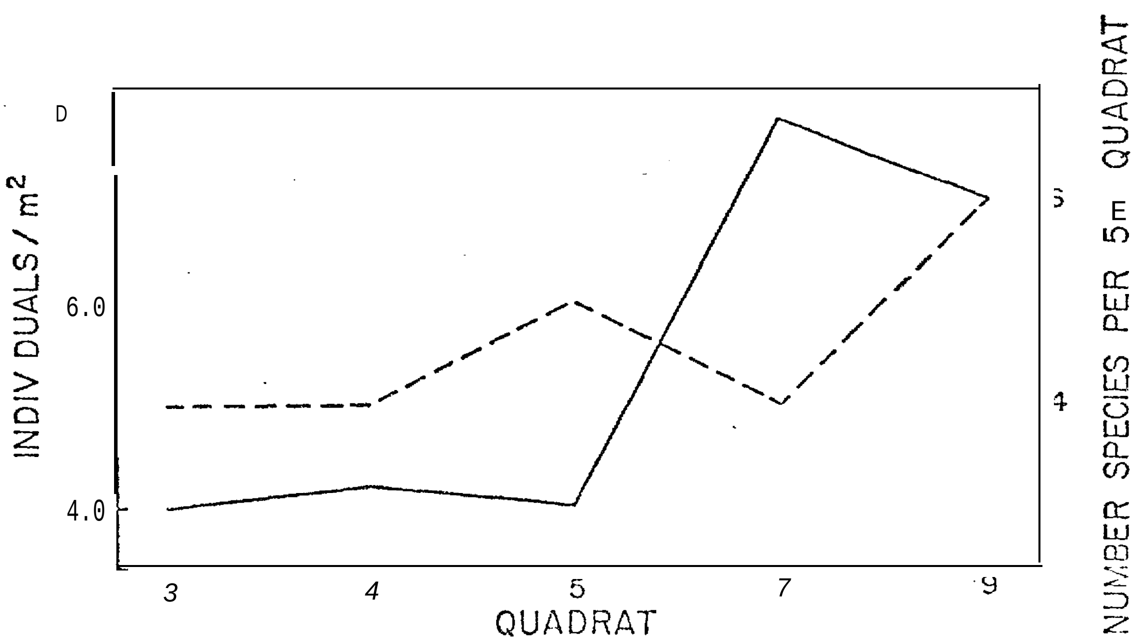
19-247 SC


A
1.50
1.30
He'
1.00
0.50
J'
1
3
6
8
10
QUADRAT


B
10.0
6.0
2.0
INDIVIDUALS / m²
7
5
3
NUMBER SPECIES PER 5m QUADRAT
i
3
6
8
10
QUADRAT

32-247 SC


C
1.00
1.20
1.00
0.50
J'
3
4
5
7
9
QUADRAT


D
INDIV DUALS / m²
6.0
4.0
4
NUMBER SPECIES PER 5m QUADRAT
3
4
5
7
9
QUADRAT

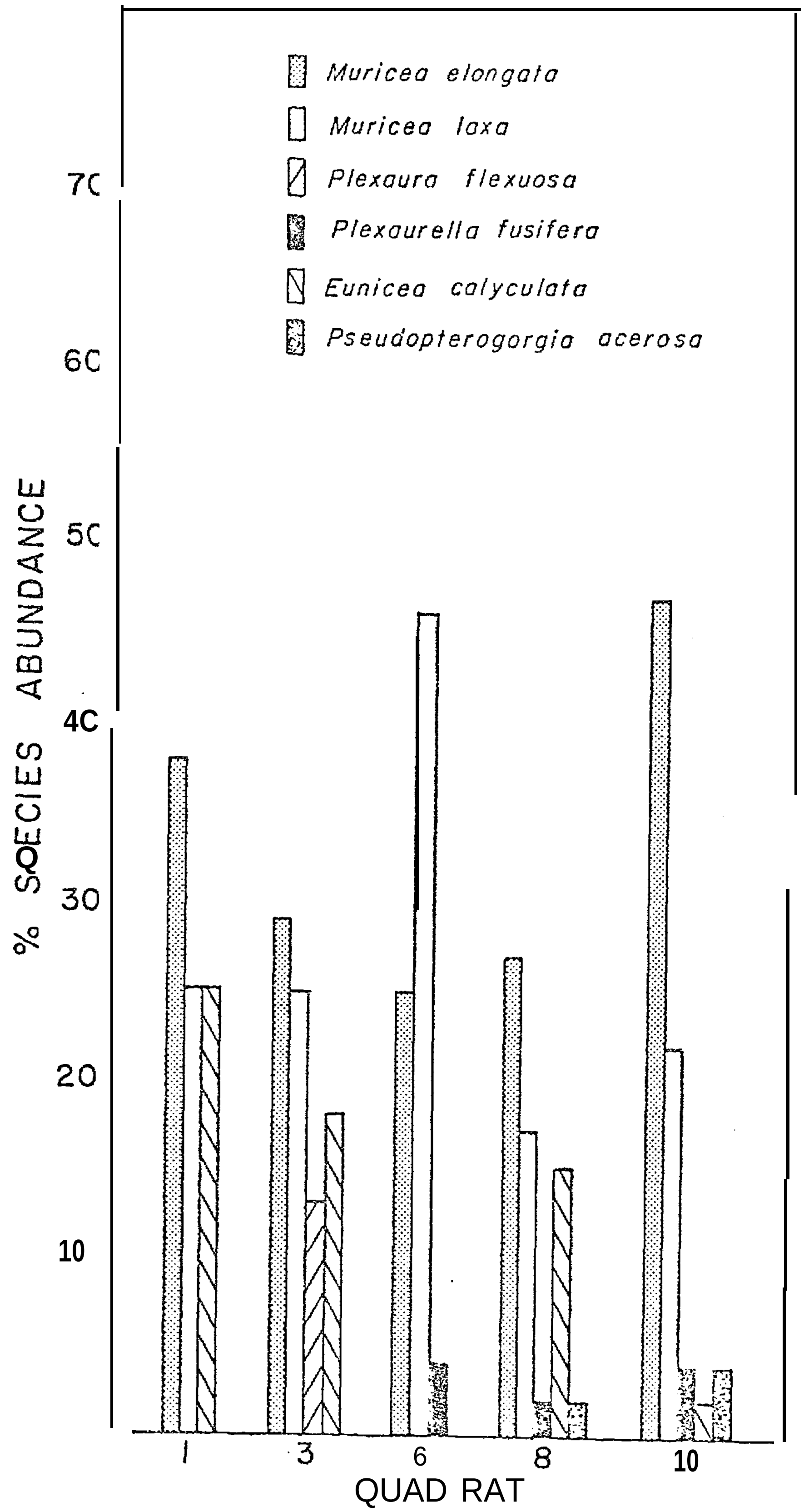


Figure 17E - Soft Coral Species Abundance , BLM 19 at Station 247.

B

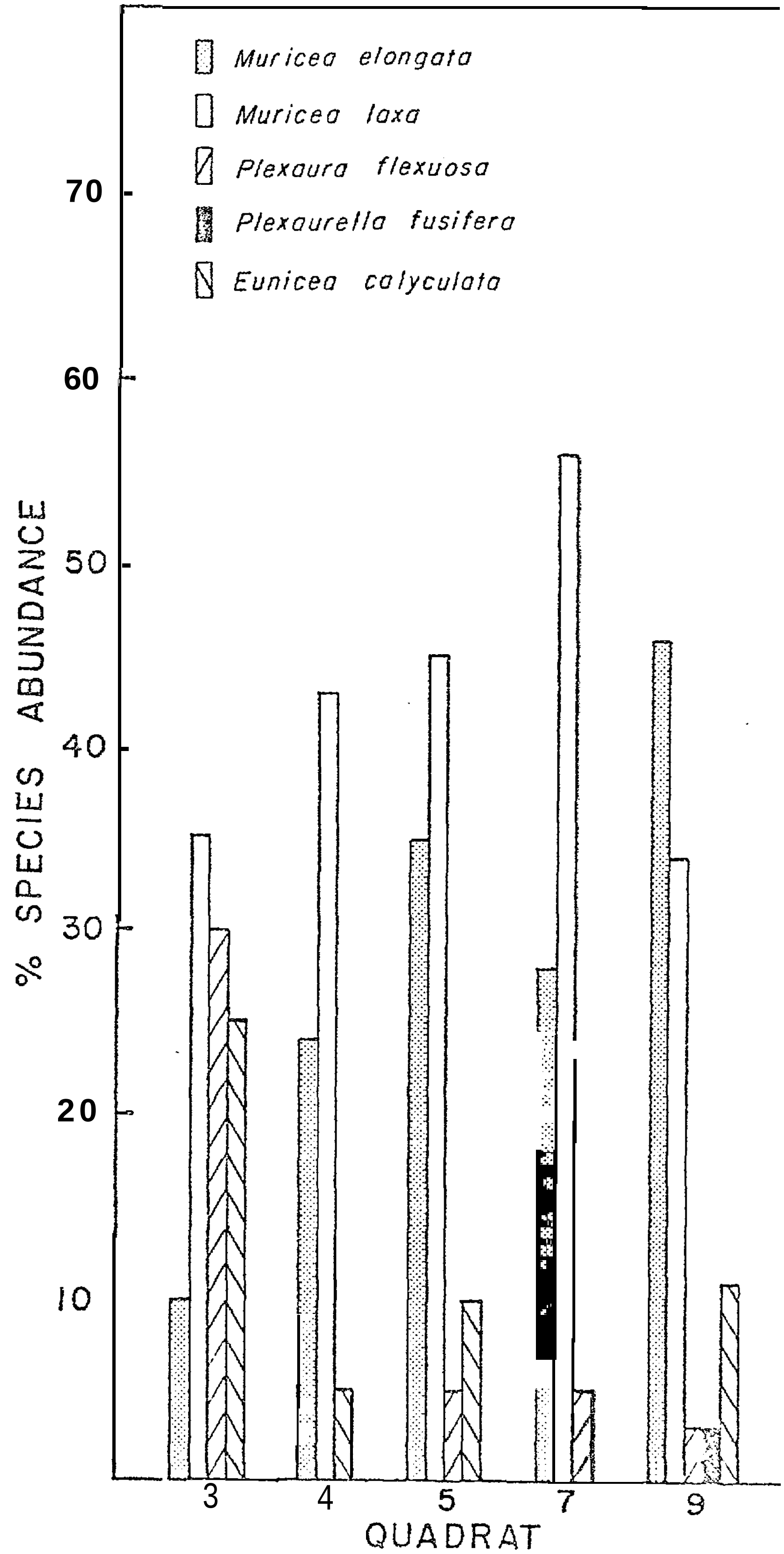


Figure 17F- Soft Coral Species Abundance, BLM 32/34 at Station 247.

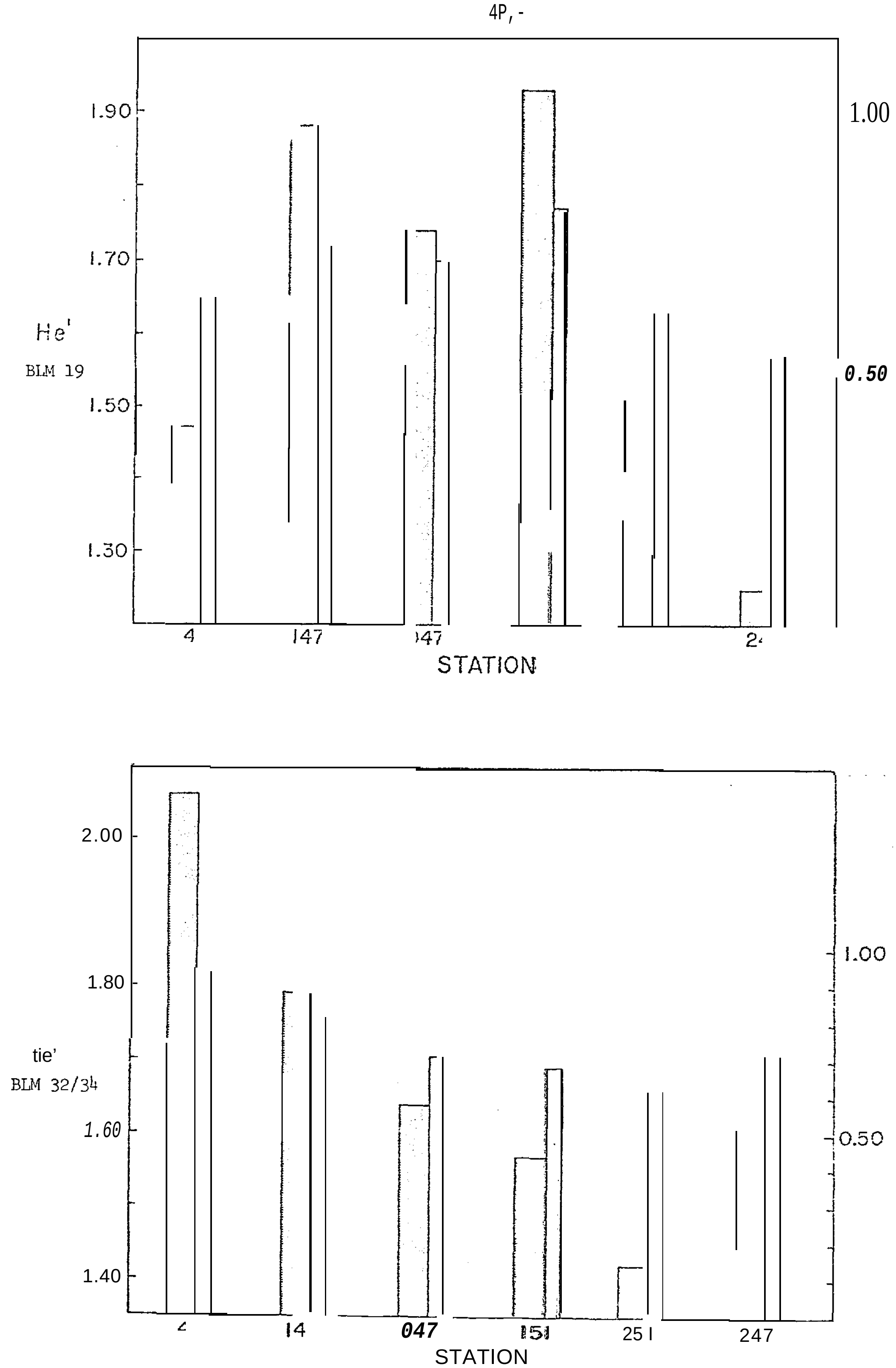


Figure 18" - Graphic Relation of Species Diversity and Evenness of Hard Corals Based on Two Transects. (BLM 19 and BLM 32/34)

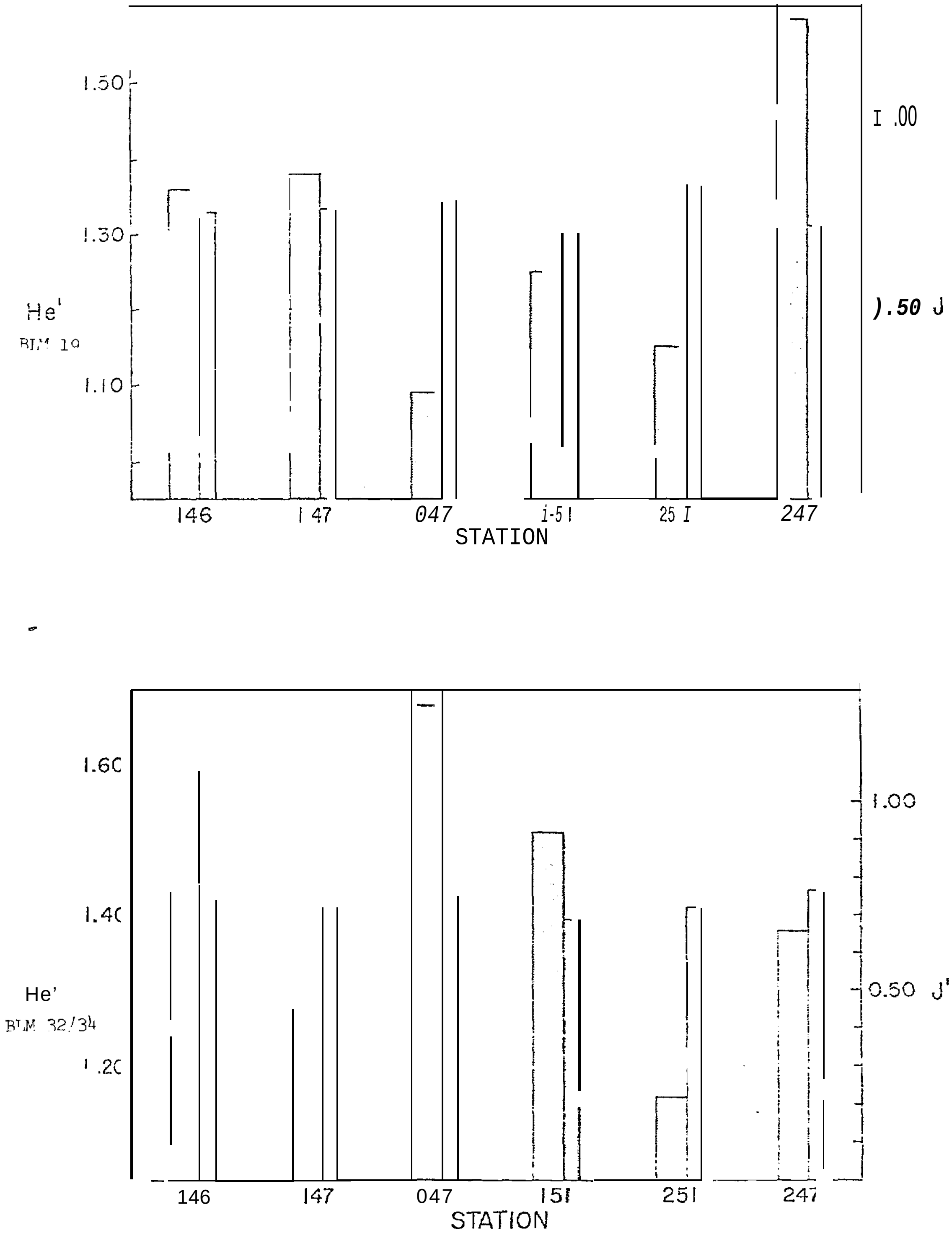


Figure 19 - Graphic Relation of Species Diversity and Evenness of Soft Corals Based on Two Transects. (BLM 19 and BLM 32/34)

DISCUSSION

A. The Dredging/Trawling Program

1. Overview

The results of the dredge/trawl program are portrayed by group in Figures 1 through 5. These trellis diagrams are constructed in such a way as to group all stations in-seriatum by depth, e.g. IA-VIA followed by IB-VIB, etc. This, albeit artificial, clustering analysis presents the stations in a grouping that most readily allows us to see inter-relations between (a) all stations at the same depth, (b) all stations of the same transect but different depth, and (c) all stations of differing transects.

Example (a)

Question: What is relationship between Station IA and IVA in Figure 1.

Procedure: Locate Station IA at the side of the page and read across the column to VA. The reader finds a value of "36"; in reciprocal fashion he sees a square which is 50% solid shaded.

Answer: This tells the reader that there is a 36% Bray-Curtis similarity between Stations IA and VA

Example (b)

Question: What is the relationship between Station IA and IC in Figure 1.

Procedure: Locate Station IA at the side of the page and read across the column to IC. The reader finds a value of "18"; in reciprocal fashion he sees a square which has only a diagonal bar.

Answer: This tells the reader that there is an 18% Bray-Curtis similarity between Stations IA and IC.

Example (c)

Question: What is the relationship between Station IIA and VC in Figure 1.

Procedure: Locate Station IIA at the side of the page and read across the column to VC. The reader finds a value of "0"; in reciprocal fashion he sees an empty square.

Answer: This tells the reader that there is no Bray-Curtis similarity between Stations IIA and VC.

For the purpose of this study, this investigator proposes that greater than 50% similarity may be "highly significant" and greater than 40 but less than 50% is "highly indicative".

2. Mollusca

Figure 1 displays the Bray-Curtis similarity percentages and mosaic for the Mollusca. From the Mosaic we can see a pattern which is "highly indicative" of association with depth. That is, A stations have greater similarity to each other than they do to their corresponding B or C stations. As for the relative strength of their associations, C stations (183 m) show stronger affinities among themselves than do A stations (37 m) or B stations (91 m) in that order.

Between individual stations, "highly significant" similarities are found between IIC and VC and between IIC and IVC. Highly indicative similarity is found between II and IIC; I and IVC; II and IVC; III and VC; IV and VC; and V and VIC. Overall. this pattern suggests a cosmopolitan and substrateindependent distribution with depth.

3. Decapod Crustaceans

The inter-relations of decapod crustacean similarity are portrayed in Figure 2. The mosaic again shows both highly indicative and highly signif-icant associations with depth. As in the mollusca A, B, and C stations are showing strong inter-relationships among themselves. As for relative strength, clearly C stations (183 m) are very strong followed by A and B stations in that order.

Among A stations, highly indicative similarity is found between: I and 11A, I and IVA, I and VA, II and IIIA, II and IVA, II and VA, III and IVA, and III and VA. A highly significant. association is found between IV and VA.

Among 13 stations we see some very interesting departures from the observed patterns. For example, we might not have expected to see similarities between VIA and VB or IV and VA with IIB. On the other hand, the high values for IB, IIB, IIIB, and VB with VIB are to be expected as are the relationships of IIB with III-VIB. But again, how do we explain "VIB and IC?

Concluding our review of station similarities with a synopsis of the C stations from 183 m we return to a more uniform and predicted pattern e.g., I and IIC, II with 111 and IVC, III with IVC, V and VIC, etc.

A review of substrates from the lithologic map does not really help us because substrates are clearly changing but percentage similarities are not. We can conclude that the decapod crustacea are probably showing a cosmopolitan and substrate independent distribution very similar to moll.uses, but they have an added advantage of mobility that allows them greater latitude in their movement along a depth gradient.

4. Echinoderms

'These animals show a remarkable depth limited pattern as seen in Figure 3. Notice that they have strong affinities at A stations, reasonably strong similarities at B stations, and no similarity at all with C stations. This is a marked departure from Molluscs and Decapod Crustacea both of which showed s'crone affinities at C stations.

We note a large degree of overlap for IA through VA and between IIA and VIA along with IV and VA. Among the B stations, I and II are highly significant in similarity to IIIB and I, II and V are highly significant in similarity to VIB. As noted earlier, C stations are conspicuous by their absence.

We might very well point out again via the A station data that substrate in apparently not a major factor in their distribution. In contrast to molluscs and decapods, however, they are far less mobile and they suggest this through their apparent tight clustering.

5. Polychaetes

The polychaete data (Figure 4) is not totally coherent but, to be candid, it is more a function of collection and identification than real-time disjunctiveness. Polychaetes are not truly epifaunal, and our ability to capture them consistently in the Capetown Dredge was inconsistent. As for identification in many cases the best we could do was family or perhaps genus sp. A, B. etc. With these stipulations and reservations we do note an affinity pattern for IA and III-VA, and between 111 and VA. The similarity 'between 11A and IIIB is very high (70%) and the affinity between II and IIIC is likewise strong (67%). Since many of these data overlap the box core data, a truly more proper interpretation should be gained therein.

6. Octocorals and Scleractinia

Data for these animals similarity is presented in Figure 5 and as the title implies we have lumped two groups in order to build a larger data base for co-occurrence.

Interestingly enough we see some fairly strong patterns among B stations and among C stations. However, bearing in mind the fact that these animals really should be substrate related, we came away disappointed when we try and make a lithological association. There consistantly does not seem to be one.

B. Faunal Assemblages

1. Overview

Collard and D'Asaro (1973) have summarized the knowledge of benthic invertebrates in the eastern Gulf of Mexico and in doing so they propose three "synthetic communities" (communities or faunal assemblages synthesized from the existing literature). These were:

a. Shallow shelf communities: Carolinian affinities

b. Deep shelf communities: West Indian affinities

c. Slope communities:

Lyons and Collard (1974) have taken a less "synthetic" approach and divided the area under discussion into (a) West Florida Shelf and (b) Mississippi-Alabama Shelf. The areas of most concern to us under (a,) above are:

1. Middle Shelf I (30-60 m)

2. Middle Shelf II (60-140 m)

3. Deep Shelf (140-200 m)

B and under (b) the authors conclude "Species from these calcareous communities are essentially the same as from others further south, but diversity may be reduced".

2. Benthic Communities

The collections at hand do not fit well with the synthetic communities of Collard and D'Asaro (2973), however Lyons and Collard (1974) have taken an approach which has some faunistic support from this study. It might be proposed that the Middle Shelf I (30-60 m) be characterized by the fauna listed in Figure 20.

Figure 20

Suggested Middle Shelf I Epifaunal Assemblage
(30-60 m)

Molluscs

Pecten raveneli
Argopecten gibbus

Decapod Crustacea

Sicyonia brevirostris
Stenorynchus seticornis
Portunus spinicarpus
Solenocera atlantidis
Callapa flammea
Porcellana sayane
Scyllarus chacei

Stomatopod Crustacea

Gonodactylus cf. *bredini*

Octocorals

Bebryce parastellata

Echinoderms

Lytechinus variegatus
Arbacia punctulata
Luidia clathrata
Luidia alternata
Astropecten duplicatus

It seems apparent that the species portrayed in Figure 6 have affinities with the Carolinian Province and because of this they are cosmopolitan in the MAFLA 30-60 m zone.

Although Lyons and Collard *op. cit.* alluded to the existence of "tropical species" in the Middle Shelf they did not attempt to amplify where and how such species might occur in the Northeastern Gulf. On the other hand, Hopkins (1974), Smith and Ogren (1974) and Cheney and Dyer (1974), have clearly established the tropical. nature of the Florida Middle Ground. It is further proposed that the Middle Shelf I (30-60 m) does have areas of high relief with a. characteristic fauna. One such area, of course, is the North Middle Grounds which can be characterized by the fauna listed in Figure 21.

Figure 21

North Middle Ground High Relief Epifaunal Assemblage

Molluscs

- Spondylus americana
- Cerithium litteratum
- Pteria colymbus

Decapod Crustacea

- Stenorynchus seticornis
- Synalpheus townsendi
- Mithrax acuticornis

Echinoderms

- Ophiothrix suensoni
- Diadema antillarum
- Coscinasterios tenuispina

Octocorallia

- Muricea laxa
- Muricea elongata
- Muricea calyculata

Porifera

- Pseudoceratina crassa
- Aegeles dispar
- Cinachyra sp.

Polychaetes

- Eunice rubra
- Ceratonereis mirabilis
- Spirobranchus giganteus

Hydrozoa

- Millepora alcicornis

Scleractinia

- Madracis decactis
- Porites divaricata
- Dichocoenia stellaris

As indicated by the stony hydrozoan Millepora and the scleractinian hermatypic corals, this fauna is distinctly of a Western Indian origin and maintains a tropical affinity even though surrounded by and impinged upon by temperate species.

The Middle Shelf II (60-140 m) fauna is sharply reduced in numbers overall but shows some continuity with that by Collard and D'Asaro (*op. cit.*) for this area ("Deep Shelf Community") but not to the extent they suggested. A proposed cosmopolitan distribution for this group is found in Figure 22.

Figure 22

Suggested Middle Shelf II Epifaunal Assemblage
(60-140 m)

Molluscs

Barbatia domingensis
Lopha frons

Decapod Crustacea

Synalpheus townsendi
Hymenopenaeus tropicalis
Iliacantha subglobosa

Octocorals

Bebryce parastellata

Echinoderms

Astroporpa annulata
Stylocidaris affinis
Clypeaster raveneli

The last faunal assemblage reflects the further reduction in species which we might expect according to Lyons and Collard (*op. cit.*) as determined from previous workers. The "Deep Shelf" is suggested to contain the species assemblage found in Figure 23.

B

Figure 23

Suggested Deep Shelf Epifaunal Assemblage

Molluscs	Decapod Crustacea
Murex beauii	Parapenaeus longirostris
Tugurium caribeaum	Pyromaia arachna
	Myropsis quinquespinosa
	Palicus obesa
	Dardanus insignis
	Goneplex hirsuta

With regard to Figures 20, 21 and 23, it must be realized that these are tentative assemblages based on one year's effort, and the effort itself has some inconsistencies in the "catch data" that are not totally inexplicable. It i's proposed that the listed groups will not only hold up under additional scrutiny, but additional efforts will in fact fill in gaps and thus enlarge our data base for faunal groups.

C. The Florida Middle Ground - Diving

1. Overview

Figure 24 displays the generally known distribution of hermatypic coral communities in the Gulf of Mexico. The Florida Middle Ground is the most northern hermatypic coral community in the Gulf of Mexico (Hopkins 1974). Figure 25 shows the location of diving stations in the study area while Figure 26 generally contrasts the faunal-floral/geological makeup at the two

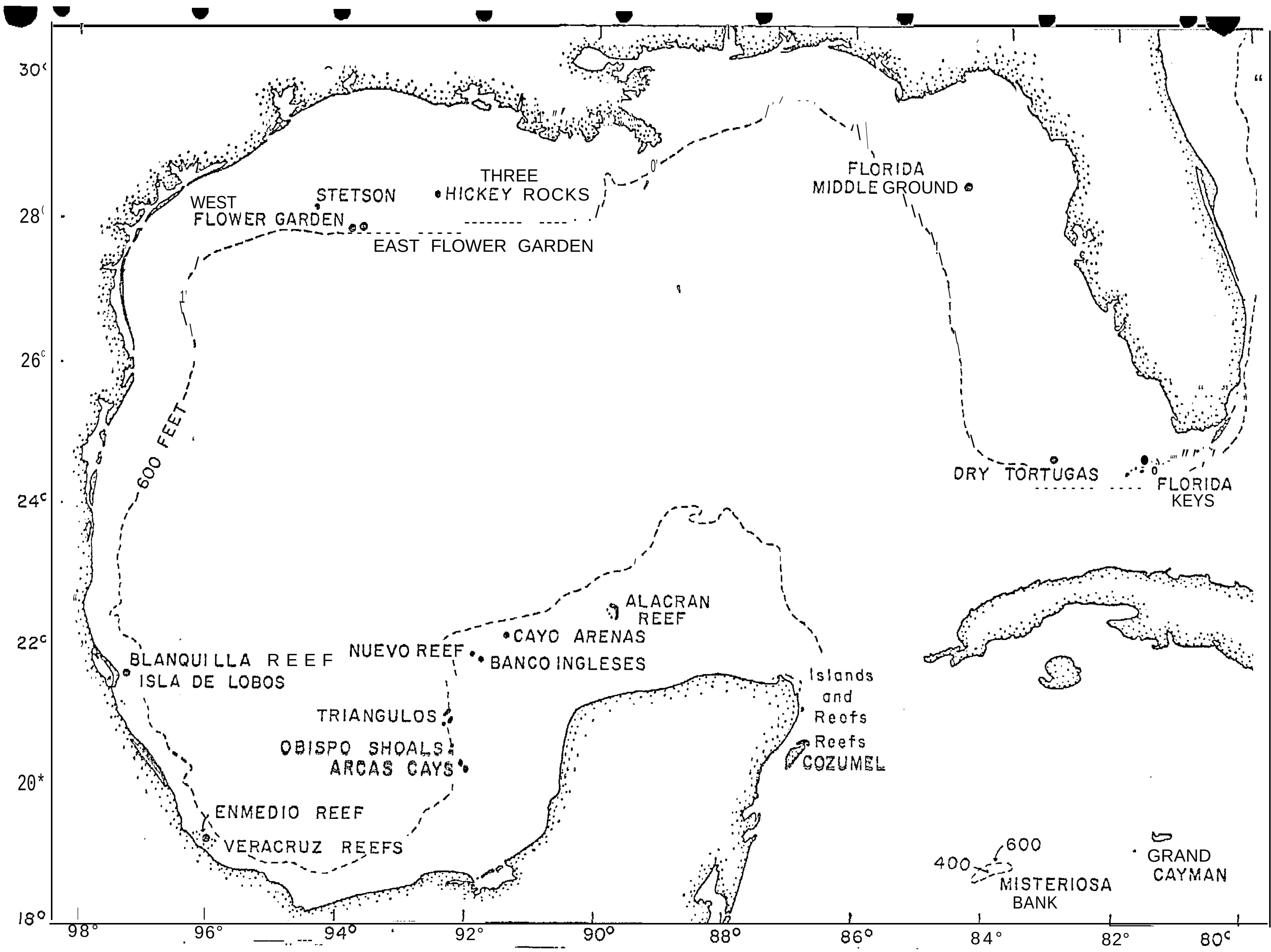


FIGURE 24 Map of the Gulf of Mexico showing locations of known coral reefs (after 1).

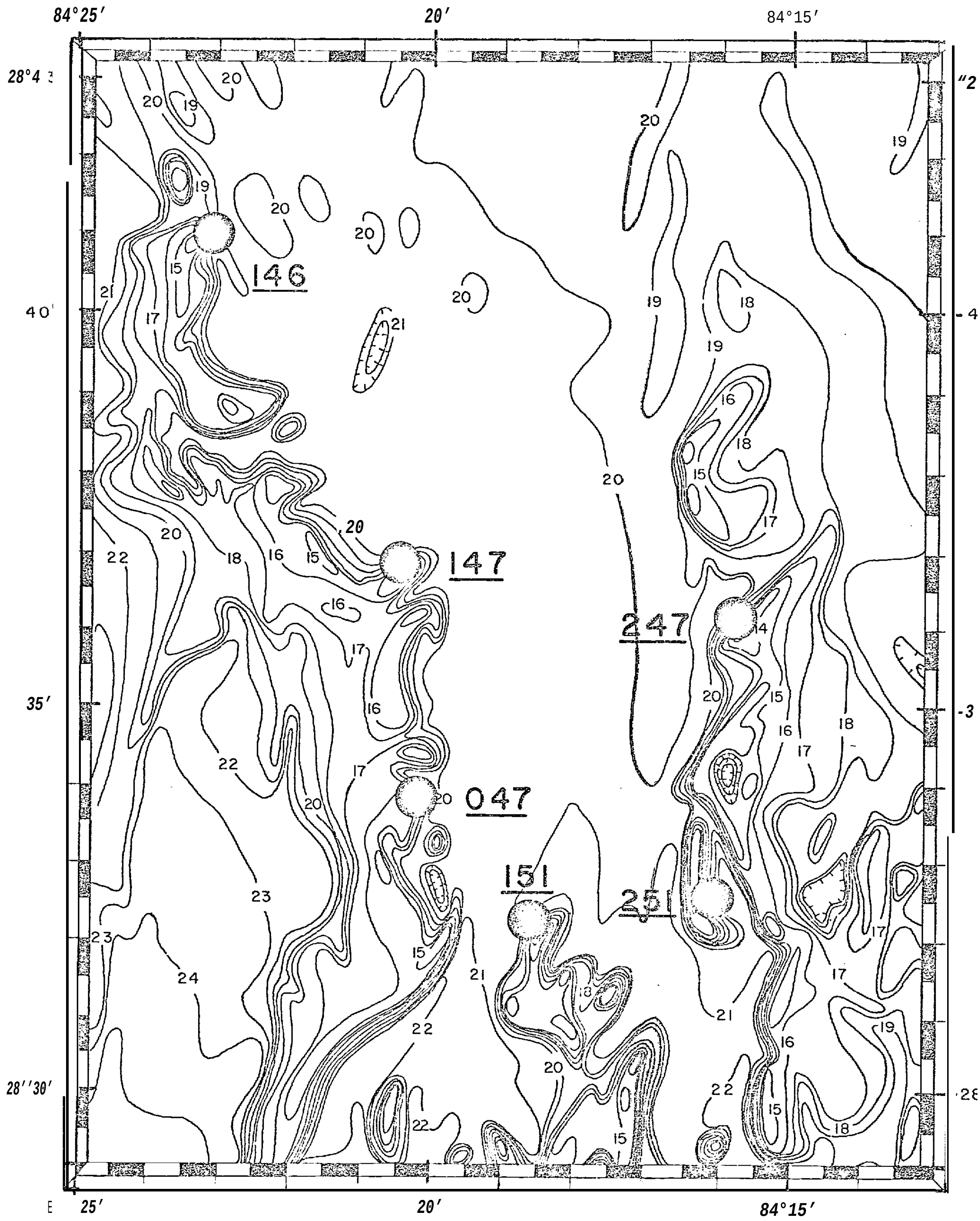


Figure 25. Location of Middle Ground stations.

sites, Station 151 and Station 247. It is estimated that we invested about 10 hr/diver scientist on the Florida Middle Ground over three seasons. Observed temperatures are in good agreement with published mean monthly temperatures.

B

2. Faunal Assemblages

a. Coelenterate

(1) General - Overall, the coelenterates of the Florida Middle Ground show strong tropical affinities. As reported earlier (Hopkins, 1974) the hydrozoan coral Millepora alcicornis forms massive colonies along the rocky margins at about 27 m depth. It is our present contention that M. alcicornis is the major contributor to frame building on the Florida Middle Ground. M. camplanata is present to a lesser extent as incrustations on octocorallian skeletons. Hydroids of note were Aglaophenia, ?Monostaechas, Plumularia, and Sertularis spp. Among the Anthozoa, tropical anemones of note were Condylactis gigantea, and Bartholomea annulata along with commensal shrimps (Periclimenes); the most wide spread anemone was Phymanthus crucifer with a variety of color patterns. Phymanthus seemed generally distributed between 25-27 m in the transected area.

P

Scleractinian and octocorallian fauna were studied quantitatively and are described elsewhere in these proceedings. Thirteen species of octocorallians were encountered along with fifteen species of scleractinian corals. Among the octocorallians the occurrence of Lophogorgia cardinalis, Diodogorgia nodulifera, Pterogorgia guadalupensis and Pseudopterogorgia rigida are new distribution records as are the scleractinian corals Cladocora arbuscula, Dichocoenia stokesii, D. stellaris, Manicina areolata, Meandrina meandrites,

P

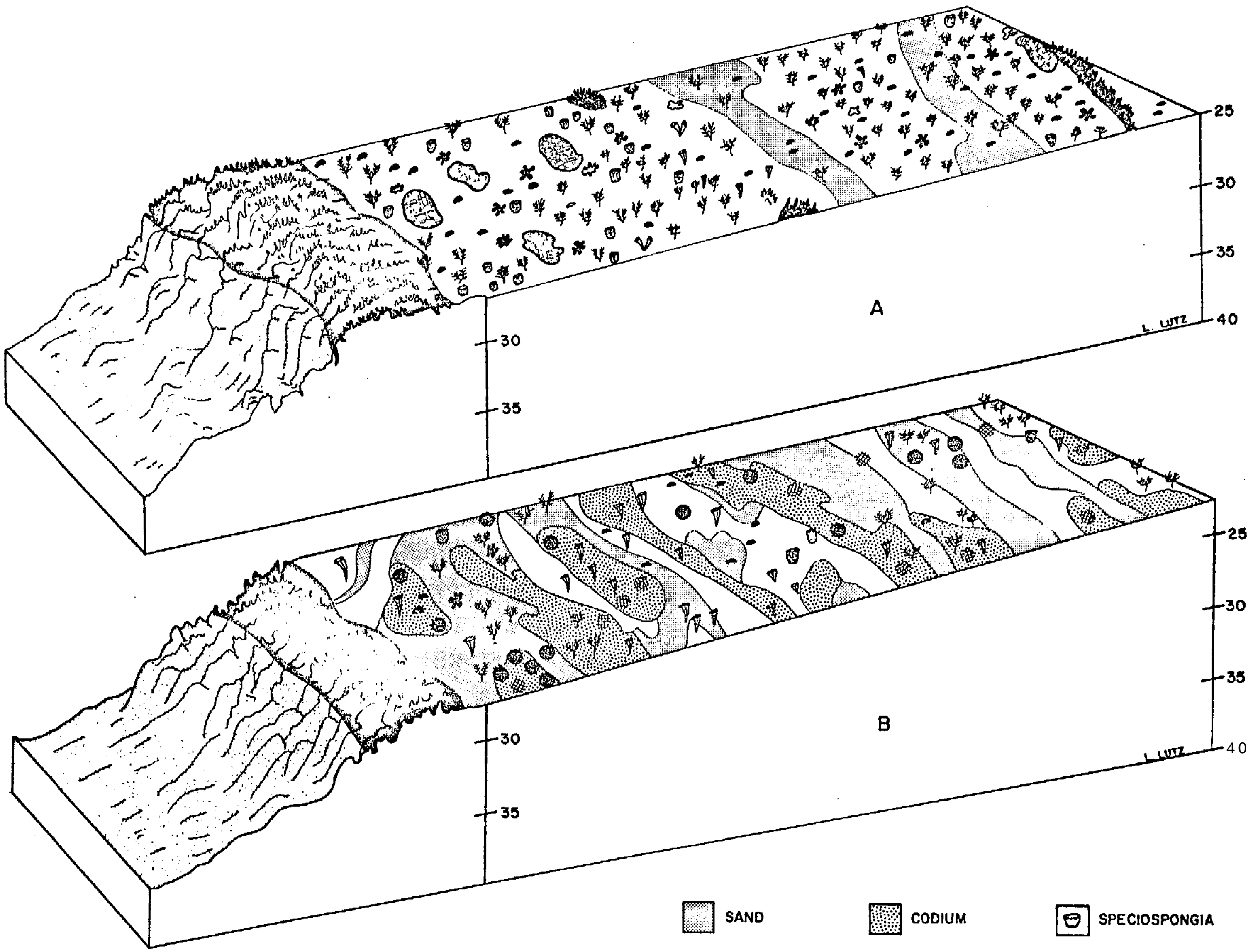


Figure 26. Cross **sectional block diagram of a transect (15 m x** 75m)
(A) station 151, western side of northeast tip of center ridge,
(B) station 247, western side of northeast ridge.

Scolymia cubensis, and Scolymia lacera.

Of the seventeen species of scleractinians reported from the West Flower Garden Bank (2), only five are in common with the Florida Middle Ground (s = 31%). Of remarkable note, however, is the fact that octocorals do not appear to occur at similar depths in the former habitat.

(2) Studies of Species Abundance and Diversity

Station 146 - Figures 6A and 6C show that hard coral diversity increases with distance from the ridge front. The evenness component (J') appears to be erratic but generally shows a concurrent increase with distance. Figures 6B and D displaying individuals/m^2 generally follow the trends set by species diversity. The number of species per 5 m quadrat clearly show the expected increase in number of species. The erratic mature of 6B illustrates the nonuniformity of the transected area being studied on that cruise. The sharp rise and fall of the lines graphically illustrate abrupt changes in topography, e.g., sand patches.

Figures 6E and 6F illustrate hard coral zonation at this site. The inverse relationship between Madracis decactis and Porites divaricata is graphically apparent; Porites replaces Madracis as a function of distance from ridge. It is also apparent that percent species abundance increases as a function of horizontal distance from the ridge.

Figures 7A and C similarly show that soft coral diversity increases "reefward." Figures 7B and D show sorer erratic patterns but, nevertheless, , the number of species per 5 m quadrat increases as expected.

Graphs of "species abundance" (Figures 7E and F) show soft coral zonation in a manner opposed by their hard coral counterparts. There does not appear to be any replacement phenomenon occurring. Muricea laxa and M. elongata do decrease in number but they are not replaced in dominances as the quadrats move "reefward." Species abundance does increase reefward, and percentages become more uniform.

In summary of 146, hard and soft corals do not appear to be competing in dominance as indicated by the similarity in values "for H'. The greater number of species of hard corals and higher species abundance does not appear to be at the expense of soft corals.

Station 147 - Figures 8A and C shoving hard coral diversity are in sharp contrast indicating (a) different locations from cruise to cruise and (b) habitat variability. A better clue to the latter [(b) above] is seen in graphs 8B and D where peaks are found in Quadrat 3 and 7 respectively abruptly followed by sharp declines. This would suggest that hard corals had encountered a habitat not conducive to their colonization, e.g., Algal or sand patches.

Figures 8E and F suggest a zonation pattern similar to Station 146.

In Figures 9A and C dealing with soft corals at this station we do not see the patterned inconsistency observed with hard corals. The low values for He' in quadrats 1 and 2 can be accounted for by the presence of Millepora and hard corals. Figures 9B and D show the same consistency with individuals/m^2 and number of species per 5m quadrat showing an increase with distance from the ridge.

Figures 9E and F indicate the dominance of Muricea laxa and M. elongata by 10-20?. The large stand of Plexaura flexuosa in 9F (Quadrat 5) may stem from the remarkable ability of this species to adapt to unstable or less desirable substrata. This ability is portrayed by variation in forms from tall erect to low stolon-like colonies.

Overall there appears to be a slight inverse relationship between hard and soft corals as seen by decreasing abundance and species diversity in hard corals with a concomitant increase in soft corals from the reefface reefward.

Station 047 - As seen in Figures 10A and C hard coral diversity declines rapidly from Quadrat 1-10. Figures 10B and D are studies in contrast because the transects involved different zonation patterns at the same site. (This is also evident in Figures 10E and. F). In contrast to Stations 146 and 147, *Madracis* is not dominant, in Figure 10, whereas *Porites* continues its increasing dominance in both 10E and 10F. These figures show *Dichocoenia stellaris* exhibiting an unusual dominance at this station; a pattern not repeated at other stations.

Continuing our contrast to 146 and 147, Figures 11A and C show a peak midway through the transect and then a decline as the transect moves reefward. Figures 11B and D additionally mirror this fact. On the other hand, Figures 11E and F show zonation patterns similar to 146 and 147 in which *Muricea laxa* and *M. elongata* continue their dominance. A further comparison of 11E and F offers credence to the fact that the transects involved different substrates at the same site (Figure 11F is considerably richer overall).

Station 047 has an unusual. configuration in that there is no distinct ridge and there is no distinct depth change. The basic configuration is flat and the inverse relationship between *Madracis* and *Porites* is distinct.

Station 151 - This station repeats some of the patterns of inconsistency seen at other stations. Whereas Figure 12A shows a steady increase in Hc', 12C indicates a very erratic net increase in hard coral diversity which further indicates the erratic nature of the area transected. Figures 12B and D generally mirror the foregoing suggestions.

The species abundance figures (12E and F) also show the inconsistency encountered at other stations. Figure 12E shows a typical replacement Pattern between Madracis and Porites along with an increased dominance of Dichodoenia stellaris. In contrast, Figure 12F does not mirror a replacement pattern and Madracis is inconsequential throughout. The emergence of Dichocoenia and Scolymia would indicate an increase in hard substrate which would replace Porites which competes well on unstable substrates.

Puzzlingly enough, the soft corals show a pattern of classic consistency. (Figures 13A and C along 1313 and Classic consistency is also seen in the zonation pattern for soft corals where Muricea laxa and M. elongata predominate.

In summary, although hard corals have a larger number of species and higher species diversity, they do not appear to be restraining the development of soft coral fauna which is remarkably high and consistent in both transects.

Station 251 - Hard coral diversity at Station 251 is limited to only one transect due to time restrictions during the winter season. The data at hand, Figures 14A and. B provide some interesting intra-station contrasts. Figure 14A shows an erratic pattern of species diversity with a peak at Quadrat 3; in contrast this same quadrat shows "sharp dips in individuals/m^2 Figure 14B). It is noteworthy that this quadratoccurs in the transition zone between the ridge and the reef flat area. Figure 14B also shows that, there is an increase in individuals/$n/^2$ even though the number of species/5 m decreases. Figure 14C indicates that Porites divaricata accounts for this phenomenon . This figure also shows the competition between Madracis and Porites.

Figures 15A and C reflect, inexplicable,' inconsistencies for no evident reason; field notes indicate that the area was flat and reasonably consistent. Figures 15B and D are more consistent in showing an increase in individuals/m^2 and an equal number of species per 5 m Quadrat (4/Quadrat 8).'

Figures 15E and F show the expected dominance of Muricea, however, M. elongata is dominant to M. laxa and Eunicea calyculata makes a strong showing.

Of all stations considered in this report, Station 251 is the most impoverished for hard and soft corals.

Station 247 - . Species diversity indices for hard corals at this station (Figures 16A and C) show a general decline as the transect ascends reefward. The peaks at Quadrats 3 and 5 in 16A arid C respectively probably reflect the relative positions of the transition zone for each transect. Figures 16B and D reinforce this suggestion as seen in the respective high points for number of species/5m quadrat.

Figures 16E and F are a study in contrast, Whereas 16E does not show a relationship between Madracis and Porites, it is clear that 16F shows the pattern usually encountered at other stations.

With regard to soft corals we see the same erratic pattern in species diversity (Figures 17A and C) that we saw in hard corals at this station. The sharp fluctuations in both graphs reflect the same variability along this transect. Figures 17B and D indicate a very consistent increase in individuals/m and number of species as the transect proceeds from the reef-face.

As expected Muricea laxa and M. elongata are the dominant soft corals (Figures 17E and F).

Overall, it does appear that there is an inverse relationship between hard and soft corals at this station. That is hard coral individuals/m^2

decrease as soft coral individuals/m^2 increase from Quadrat 1 through 10 on either transect. This is in spite of the habitat irregularity.

Figure 18 shows a graphic comparison of diversity and. evenness for hard corals study station by station via two transects. The contrasting results are remarkable in their inconsistency. The same is essentially true for soft corals (Figure 19). Cumulative diversities (not graphed) would suggest that hard coral diversity is highest on the western ridge line and lowest on the eastern ridge. Soft coral cumulative diversities favor a north-south gradient with higher diversities being found at the northern and southernmost stations.

b. Mollusca - The present study reports 75 species of molluscs from the Florida Middle Ground which includes 43 species of gastropod, 24 species of pelecypods, three species of cephalopods, and two polyplacophoran species. Particularly noteworthy among the gastropod are two species of opisthobranchs of which one has just been described as new to science.

Studies of a similar nature in the western Gulf are those of Tunnel (1974) who reported 290 species (211 gastropod, 73 pelecypods, two cephalopods, and two polyplacophorans) from Enmedio and Lobos reefs along the Mexican coast. (Figure 1); depth ranged from supralittoral to 23 m. Lipka (1974) reported 65 molluscs from the West Flower Garden Bank which included 41 gastropod, 21 pelecypods, two cephalopods, and one polyplacophoran species. The occurrence of opisthobranch molluscs was not reported.

Of the material presently reported from the Middle Ground effort, only eight species of gastropod coil.ectecl also 'occurred at the Flower Garden site. *Cerithium litteratum* was the most abundant gastropod surveyed *in situ* at either site. Of the 24 species of Middle Ground pelecypods collected, only seven were found to be in common with the West Flower Garden Bank. *Lithophaga* bisulcata was less abundant than L. aristata. Malleus candeanus was found as an inhabitant of sponges during this study, but. Lipka (1974) reports it only from hard substrate. Other prominent pelecypods were Chlamys benedicti, Chama macerophylla, Lopha frons, Pteria colymbus, and Spondylus americanus.

The Middle Ground molluscan assemblage is quite dissimilar (X = 23%) from the West Flower Garden Bank.

Decapod Crustacea - This group is represented by fifty-six species from six sections and eighteen families. Families with major contributions are Palaemonidae (12 species), Majidae (11 species), Xanthidae (10 species), and Alpheidae (nine species). Among the decapods collected, approximately ten to fifteen percent (seven-eight species) will probably end up being new to science. A particular example is Pseudocryptochirus hypostegus n. sp. a commensal of Agaricia fragilis currently being described (Shaw and Hopkins, 1977). Of pertinence too, are new records for Synalpheus brevifrons, Trachycaris restricts, Alpheopsis labis, Periclimenaeus bredini, P. pennyae, P. ascidiarum, P. perlatus, Periclimenes iridescent, Gnathophyllum modestus, Pontonia margarita, and Lysmata rathbunae from among the caridean shrimps alone. It is of further pertinence to note that there is very little overlap in species occurrence between the Florida Middle Ground and the West Flower Garden Bank (Pequegnat and Ray, 1974). F'or example, although they report sixteen species of alpheids, only three are in common with the nine species encountered during this study. Of contrasting interest is the greater number of palaemonids (1.2 vs seven species) and the presence of stenopid shrimp on the Florida Middle Ground. Stenopus hispidus and S. scutellatus are established on the Florida Middle Ground, but were not reported from the West Flower Garden Bank.

The greater number and dissimilarity (S = 34%) of the Middle Ground Decapod Crustacean fauna. is in keeping with our observations about the coral fauna. Furthermore, the more diversified habitat located in the northeastern Gulf of Mexico apparently provides opportunities 'for the occurrence of both semi-tropical and temperate species occupation.

Echinoderms - the echinoderms on the deep reefs of both the Middle Ground and the Flower Garden Bank are somewhat less well represented than other fauna. The principal asteroid is Coscinasterias tenuispina which is found both up on the reef proper and in the valleys between major formations. Echinaster sp., Oreaster reticulates, and Narcissia trigonias all inhabit the sand floor at about 36-37 m depth. With the exception of a single station (No. 247), Diadema antillarum is the primary echinoid followed by Arbacia punctulata and Lytechinus variegatus: at Station 247 A. punctulata quite unexpectedly and unexplainably replaces the abundant Diadema. Eucidaris tribuloides and Meoma ventricosa inhabit the sand-shell rubble area between major reef formations. Among the ophiuroids which contribute the single greatest number of species to the group, Astrophyton muricatum is a dominant. Its presence along the Millepora reef at night is as conspicuous as its absence during the day where it forms tightly coiled mounds deep in the large interstices of the Millepora projection.s. Ophiothrix angulata and O. suensoni are ectocommensal of sponges whereas Ophiactis sp. is an endocommensal of Aegeles dispar, an orange sponge. Burke (1974) regards this Ophiactis as being O. savi gnyi, however, we regard the Middle Ground form as definitely not being O. savi gnyi and probably an endemi c.

Overall the Middle Ground reef top is considerably better represented by echinoderms than the Flower Garden Bank (23 vs. 10) and with little similarity (S = 36%) {Burke,].974).

Polychaetous Annelids - Among the 41 polychaete species encountered in the study area to date, certain forms predominate: Eunice rubra, Ceratonereis mirabilis, Hermenia verraculosa, and Spirobranchus giganteus. Members of the family Eunicidae dominate both biomass and species number. Identifiable forms with West Indian affinities were: Hermodice carunculata, Hesione picta, and Hermenia verruculosa: forms showing circumtropical distribution in warm tropical seas were: Ceratonereis mirabilis, Eunice antennata, E. siciliensis, Lumbrinereis inflata, and Spirobranchus giganteus.

It is remarkable to note that only eight species of polychaetes were recorded from the West Flower Garden Bank (Wills, 1974). We can expect a larger polychaete faunal assemblage after we complete studies underway. As in the case of the Decapod Crustacea, it is proposed that the Middle Ground is a more productive area due to greater habitat diversity and potential niches.

Poriferans (Sponges) - Of all the groups we have attempted to study, the sponges are proving to be the most difficult. This problem is primarily due to the large apparent diversity coupled with the subtlety which characterize: (or fails to characterize) a species in the field, and secondarily to the apparent lack of cohesion in recognizing or organizing sponge families at the present time. This faunal group is rich and diverse in the eastern Gulf of Mexico and is very deserving of extensive study.

We are presently working with about 40 species; the final number could well reach 100. The most well represented family is the Spongiidae with six spec (three Ircinia and three Verongia) followed by the Axinellidae with four species. Conspicuous and common species are Callypongia vaginalis, Neofibularia nolitangere, Cinachyra sp., Ircinia campana, I. strobilina, I. fasiculata, Verongia longissima, V. fistularis, V. cauliformes, Pseudoceratina crassa, Sphaeciospongia vesparia, Haliclona rubens, Placospongia sp., Mycale angulosa, and Agelas dispar. Agelas dispar seems to be the only restricted species as it occurs along the reef face at 30-32 m; the others are generally well distributed over the depth range.

Cursory review of manuscript information dealing with the Flower Garden Bank sponges indicates very little similarity between the two areas.

Fishes - One hundred-seventy species of fish from 56 families have been observed and/or collected. on the F1.c.rids Middle Ground. Of these, 97 are considered primary and 45 as secondary reef fishes as defined by Starck (1968). The greatest familial representation is by the Serranidae with 21 species followed by Gobiidae (eight species) , and Pomacentridae, Labridae, and Balistidae each with seven species. Numerically (biomass and numbers of individuals) important members of the community include Mycteroperca microlepis, M. Pherax, Holancanthus bermudensis, Chromis scotti, Halichoeres bivattatus, Scarus croicensis, Gobiosoma oceanops, and G. xanthipora.

The Millepora ridge serves as both a focal point and demarcation zone between shallower back-reef species and deeper Yore-reef species. During the day, large aggregations (100-300 individuals) of Chromis scotti are found consistantly feeding in the water column two-to-five m above the ridge; large groups of Equetus umbrosus and Holocentrus asensionis remain within the large crevices of the ridge, but below these crevices beneath the ridge line Centropristes ocyurus, Chromis enchrysurus, and Sparisoma stoma.rium are in frequent residence. In the more reefward, octocorallian zone. Eupomacentrus variabilis, Chromis scotti, Holocanthus bermudensis, Halichoeres bivattatus and Scarus croicensis are common inhabitants.

A comparison of the deep reef ichthyofauna of the Middle Ground with that of shallower water (12-18 m) reefs of the Eastern Gulf of Mexico reveals a far richer and more tropical faunal tropical assemblage with increasing depth. Seventy-one species have been reported from these shallow reefs, 44% of which also occur on the Middle Ground which additionally harbor many insular species not found on the shallow reefs (Smith, 1976) . It has been postulated that buffered environmental conditions associated with offshore distance, reef structural complexity, water col umn and bent hic pri mary productivity are important features contributing to Middle Ground diversity and abundance (Smith and Ogren, 1976).

Although Starck(1968) cautioned against using a quantitative index of faunal similarity because it may not consider variations in geography, hydrography or reef biology, such an index does reveal certain interesting relationships. For example, comparisons of the Middle Ground and other Western Atlantic reef ichthyofaunas reveal greater Caribbean-West Indian affinity and intra-Gulf homogeneity than previously expected. The Middle Ground reef ichthyofauna is most closely allied to that of the Florida Keys (S = 49%). Comparisons with the West Flower Garden Bank ichthyofauna (Bright and Cushman, 1974) show a 44% similarity (this is considerably higher than any of the invertebrate values). This greater similarity may be the result of occupation of these deep reefs by stenoecious and insular fishes.

Floral Assemblages

Algal Composition - At the present time, we are able to report 1.03 species of algae from this study of which 48 species (14 Chlorophyta, five Phaeophyta, and 29 Rhodophyta) are new to the Middle Ground; 20 are new range records. Our list coupled with Cheney and Dyer (1976) brings the

Middle Ground total to about 140 species. We estimate that at least four new species are in order, however, they will be treated in detail. elsewhere.

Commonly encountered members of the Chlorophyta were Anadyomene stellata, Bryopsis pennata, Caulerpa microphysa, Codium carolinianum, C. intertextum, C. isthmocladium, Ernodesmus verticellata, Halimeda discoidea, Udotea flabellum, and Valonia macrophysa. Among the Phaeophyta, Dictyota bartayresii and D. dichotoma are well distributed. The Rhodophyta were represented by Amphiroa fragilissima, Botryocladia occidentalis, Coelarthrum albertisii, Erythrocladia subintegra, Eucheuma isforme, Galaxaura oblongata, Halymena spp., Kallymenia perforata, Laurencia intricata and Paragonolithon sp. to mention a few.

Algal Distributions - Overall, red algae are the most diverse, comprising 61% of the species present , with Chlorophyta contributing 28% and. Phaeophyta 11%. Abundance in any given area varies widely, however', with species of Chlorophyta often dominating in terms of biomass.

In winter, the total. number of species is about one-third of the total present in early summer arrd autumn. The two species of brown algae found in February, Dictyota dichotoma and Dictyota bartayresii, are essentially warm-water plants. Encrusting Rhodophyta are perennial, but most of the fleshy, filamentous, and leafy red algae die back during the winter and were represented in the February collections by small "germlings". These included Kallymenia, Coelarthrum, and Champia -- species that exhibit luxuriant growth by June and make up much of the biomass of the reds present in summer and early autumn. Filamentous reds were most conspicuous and abundant in early autumn.

Most of the plant biomass present in winter consists of perennial green algae including Codium carolinianum, Codium intertextum, Valonia macrophysa, Halimeda discoidea, and Udotea flab-hum.

Throughout the year, there is greater diversity and abundanceofplants present in the northern part of the Middle Ground than in the southern region. Two interacting biological factors may account for this. 'The southern stations include extensive areas of branching corals with associated populations of herbivorous fishes. It is likely that competition for space on hard substrate necessary for many corals and many plants, reduces the potential opportunities for spore settling and survival. Coupled with this is the grazing pressure exerted by numerous parrotfishes and damselfishes, and to some extent, herbivorous sea urchins. Although corals and herbivores occur throughout the Middle Ground stations, they are most abundant in the southern area.

Wire cages were placed at various locations during June, 1975 to exclude grazers. Unfortunately, the cages were destroyed by Hurricane ELOISE before definitive observations could be made.

Storm Effects - The effect of Hurricane ELOISE in September, 1975, was drarratic and substantiates Cheney and Dyer's (1974) observations that autumn storms may cause drastic reduction of plants through scouring and wave action. Some species were completely eliminated. from Middle Ground sites a-t which they had been abundant only a week before. Reduction of red algae was especially evident. Halymenia plants, formerly large, luxuriant blades, were torn or reduced to only a holdfast with a small residual stipe and blade fragment. The spherical green alga, Valonia, was often found plasmolyzed, perhaps a result of wave action'. Many fleshy and leafy species were cut off by the rapid flow of sediment over the reef.

The cumulative eff'eels of laterautumn and winter storms were even more

B

severe. Sandy areas became churned into deep sand ripples and extensive *Caulerpa* communities were destroyed. Some *Caulerpa* was found in adjacent areas on hard substrate, apparently less affected by sand movement. *Botryocladia occidentals* plants were often sheared abruptly to one half their former size, as were other common species.

Despite the apparent devastation caused by autumn and winter storms, it is evident from three seasons of observations (1974, 1975, 1976) that the plant populations recover each year with the coming of summer.

4. Conclusions about the Florida Middle Ground

There are very strong and positive indications that the Florida Middle Ground has unique faunal and floral. assemblages which make it dissimilar from the West Flower Garden Bank reef in the northwestern Gulf. This may very well be explained by the apparent circulation patterns which bring larvae and/or "sporlings" to the respective areas. It is proposed that the Florida Middle Ground is maintained by the Loop Current (Austin and Jones, 1974) bringing water from the Bahamian and Florida Keys environments whereas the West Flower Garden Bank is maintained by the Mexican Current (Sturges and Blaha, 1976).

REFERENCES

Austin, H. and J. Jones, 1974. Seasonal variation of physical oceanographic parameters on the Florida Middle Ground and their relation to zooplankton biomass on the West Florida Shelf. Quar. J. Fla. Acad. Sci 37(2).

Ray, J.R. and J.T. Curtis, 1957. An ordination of the upland forest communities of southern Wisconsin. Ecol. Monogr., 27: 325-349.

Bright, T.J. and C.W. Cashman, 1974. Fishes p. 340-409 in Biota of the West Flower Garden Bank. Ed. Bright T.J., and L.H. Pequegnat. Gulf Publishing co. 435 pp.

Bright, T.J. and L.H. Pequegnat, 1974. Biota of the West Flower Garden Bank. Gulf Pub. Co., Houston, Texas. 435 pp.

Burke, T.E., 1974. Echinoderms p. 312-331 in Biota of the West Florida Garden Bank. Ed. Bright, T.J. and L.H. Pequegnat. Gulf Publishing Co. 435 pp.

Cheney, D.P. and J.P. Dyer, III, 1974. Deep-Water benthic algae of the Florida Middle Ground. Mar. Biol. 27, 185-190.

Collard, S.B. and C.N. D'Asaro, 1973. Benthic invertebrates of the Eastern Gulf of Mexico. 27 p. In: A summary of knowledge of the Eastern Gulf of Mexico 1973. State University System of Florida Institute of Oceanography, St. Petersburg, Fla.

Hopkins, T.S., 1974. Observations on the Florida Middle Ground through the use of open-circuit SCUBA. In R.E. Smith, Ed. "Proc. of Mar. environ. implications of offshore drilling eastern Gulf of Mexico: 1974" p. 227-228.

Lipka, D.A., 1974. Mollusks. p. 143-196 in Biota of the West Florida Garden Bank. Ed. Bright, T.J. and L.H. Pequegnat. Gulf Publishing Co. 435 pp.

Lyons, W.G. and S.B. Collard, 1974. Benthic invertebrates communities of the eastern Gulf of Mexico. Proc. Mar. Env. Implications of offshore Drilling Eastern Gulf of Mexico 157-165. State University System Institute of Oceanography, St. Petersburg, Fla.

Pequegnat, L.H. and J.P. Ray, 1974. Crustacea and other Arthropods p. 232-288 in Biota of the West Flower Garden Bank. Ed. Bright, T.J. and L.H. Pequegnat. Gulf Publishing Co. 435 pp.

Pielou, E.C., 1966. The measurement of diversity in different types of biological collections. J. Theor. Biol. 13: 131-144.

REFERENCES - continued

Sanders, H. L., 1960. Benthic studies in Buzzard's Bay. III The structure of the soft-bottom community. Limnol. Oceanogr. 5, 138-1.53.

Shaw, J.K. and Hopkins, T.S., 1977. The occurrence of two members of the Hapalocarcinidae (Crustacea: Brachyora) on the Florida Middle Ground. in Press. Proc. 3rd Intl. Symp. Coral Reefs.

Smith, G.B., *1976*. Ecology and distribution of Eastern Gulf of Mexico Reef fishes. Fla. Mar. Res. Pub].. No. 19, 78 pp.

Smith, G.B, H.M. Austin, S.A. Bortone, R.W. Hastingsand L.H. Ogren, 1975. Fishes of the Florida Middle Ground with comments on ecology and zoogeography. Fla. Mar. Res. Publ. No. 9, 14 pp.

Smith, G.B. and L.H. Ogren, 1974. Comments on the nature of the Florida Middle Ground reef ichthyofauna. in R.E. Smith, Ed. "Proc of Mar. environ. implications of offshore drilling eastern Gulf of Mexico: 1974. p. 229-222.

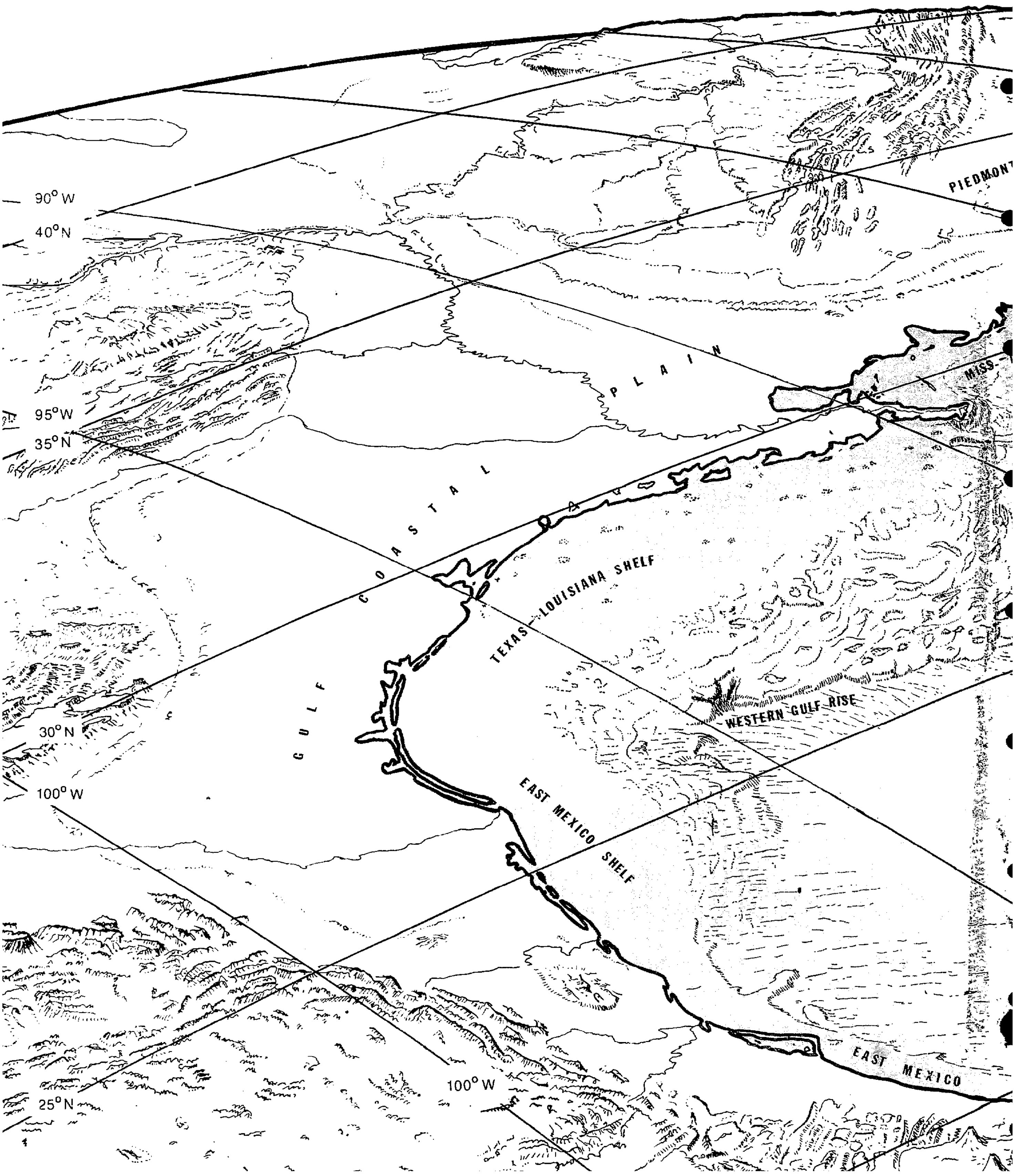
Starck, W. A., II, 1968. A list of the fish at Alligator Reef Florida, with comments on the nature of the Florida reef fish fauna. Undersea Biol. Vol. I(1), 4040.

Sturges, W. and J.P. Blaha, 1976. A Western boundary current in the Gulf of Mexico. Science, 192, 367-369.

Tresslar, R.C., 1974. Corals p. 116-139. in Biota of the West Flower Garden Bank. Ed. Bright, T.J. and L.H. Pequegnat. Gulf Publishing Co. 435 pp.

Tunnell, J.W., 1974. Ecological and Geographical distribution of Moll.uses of Lobos and Enmedio Coral reefs, Southwestern Gulf of Mexico. PhD Dissertation, Texas A&M University.

Wills, J.B., **1974.** Worms. p. 292-309 in Biota of the West Flower Garden Bank. Ed. Bright, T.J. and L.H. Pequegnat. Gulf Publishing Co. 435 pp.



90° W
40° N
95° W
35° N
30° N
100° W
25° N
100° W
PIEDMONT
MISS.
P L A I N
G U L F   C O A S T A L
TEXAS-LOUISIANA SHELF
WESTERN GULF RISE
EAST MEXICO SHELF
EAST MEXICO