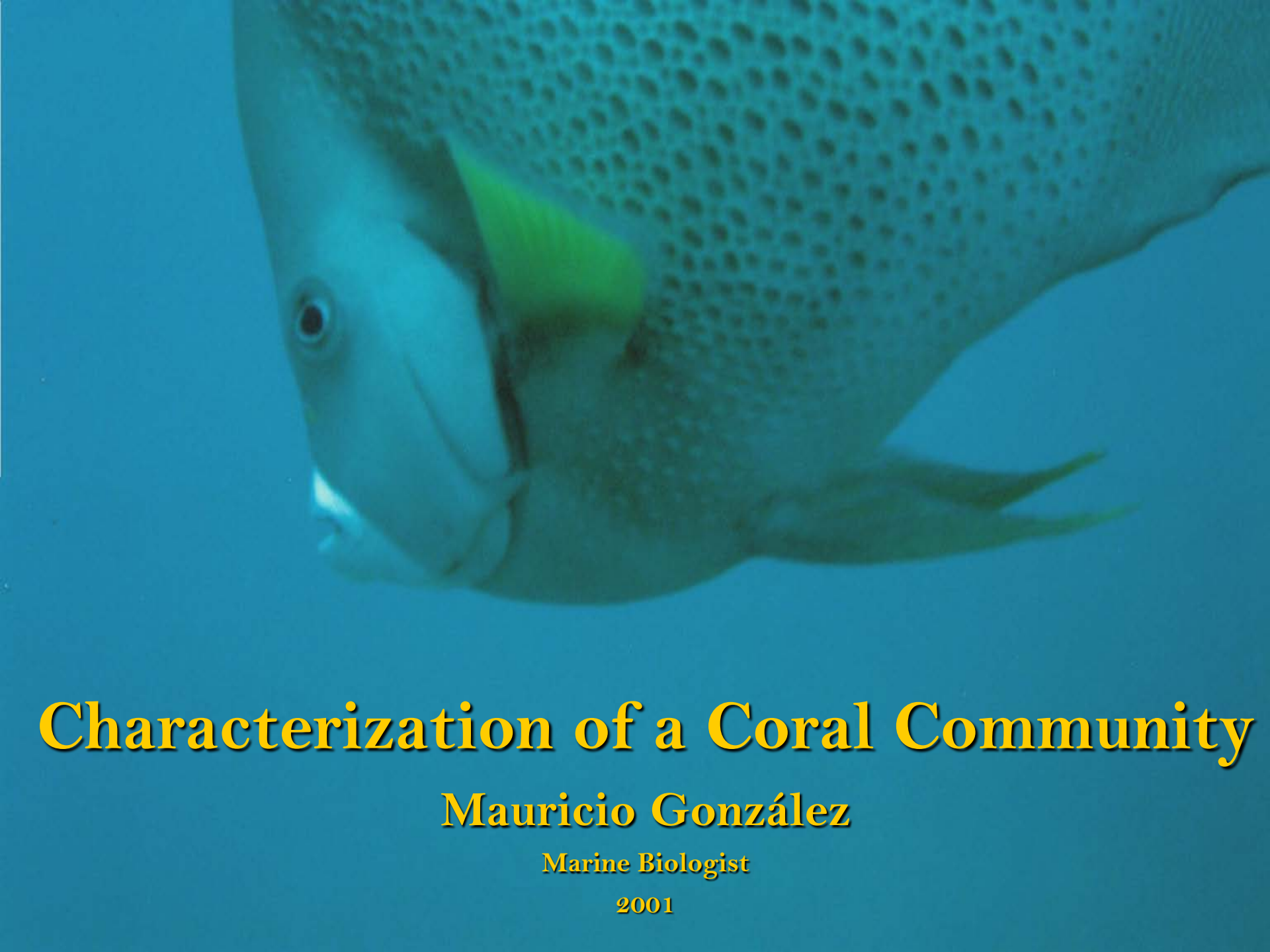
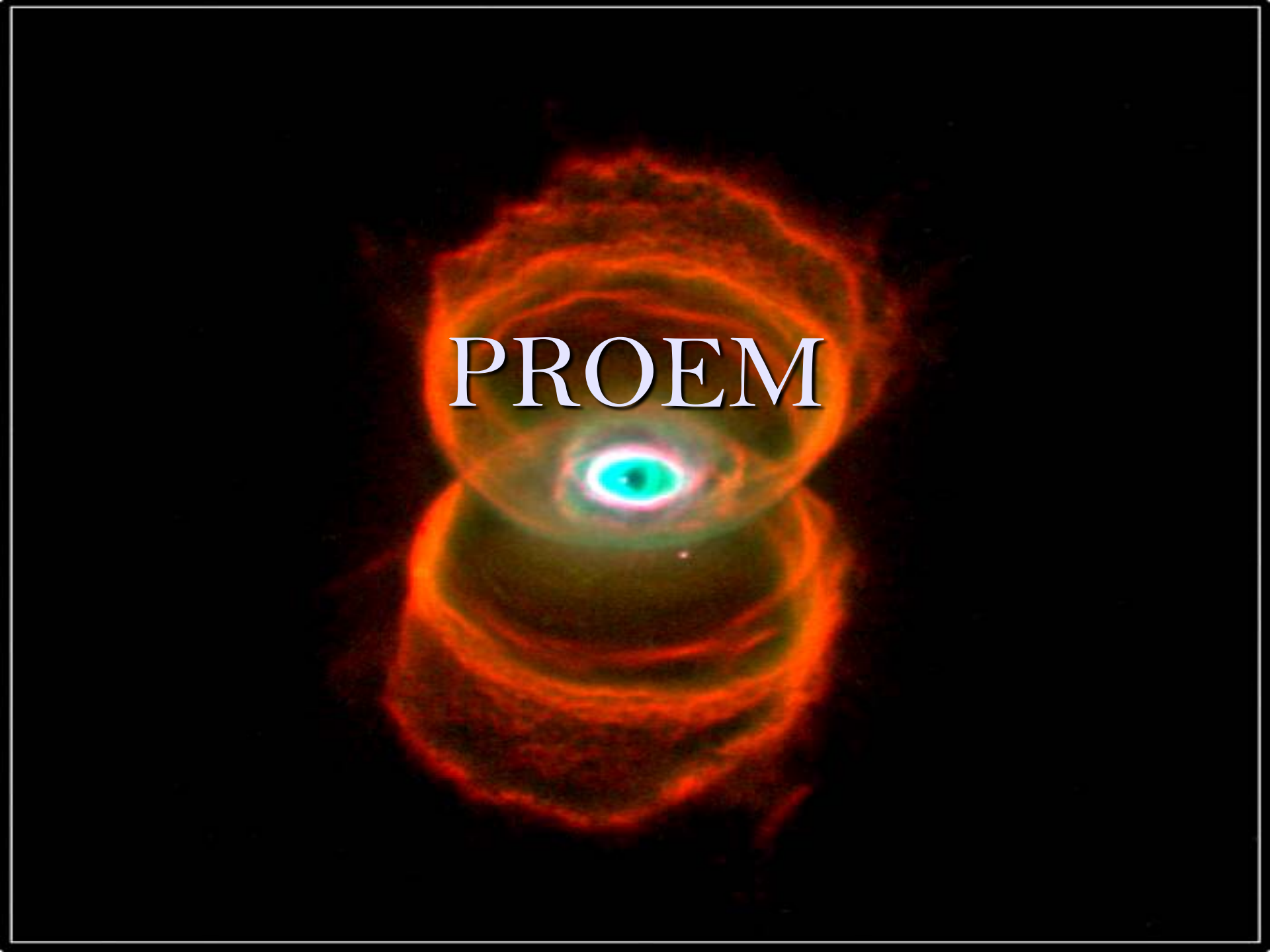


Characterization of a Coral Community

Mauricio González

Marine Biologist

2001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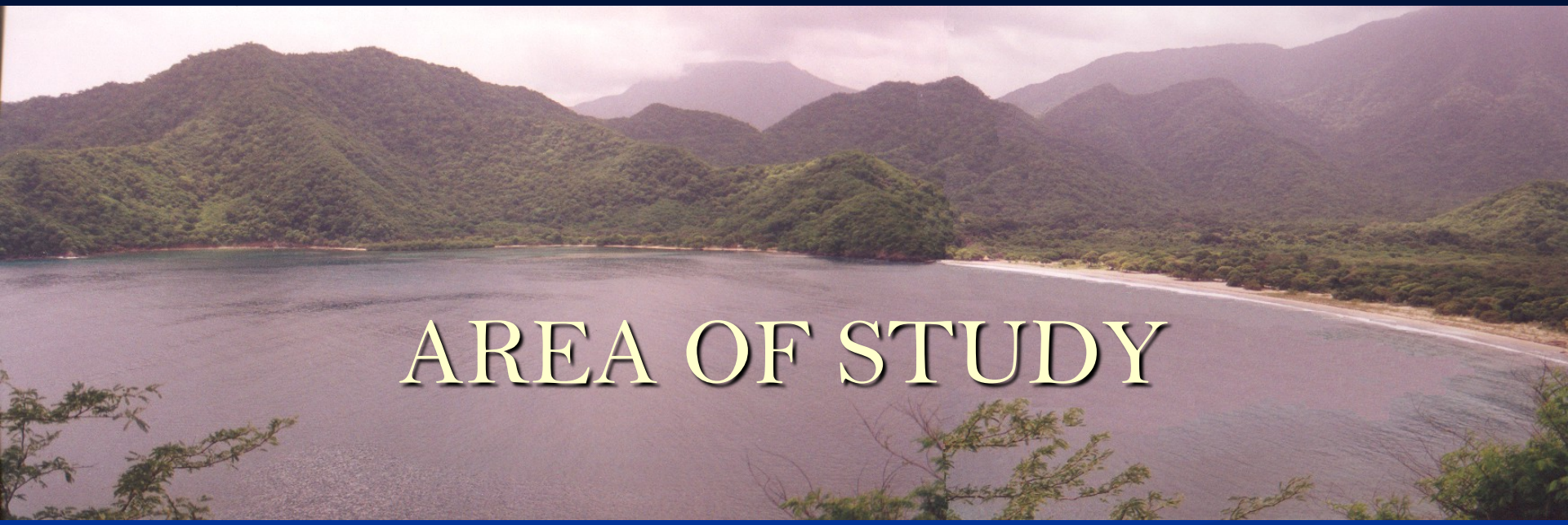
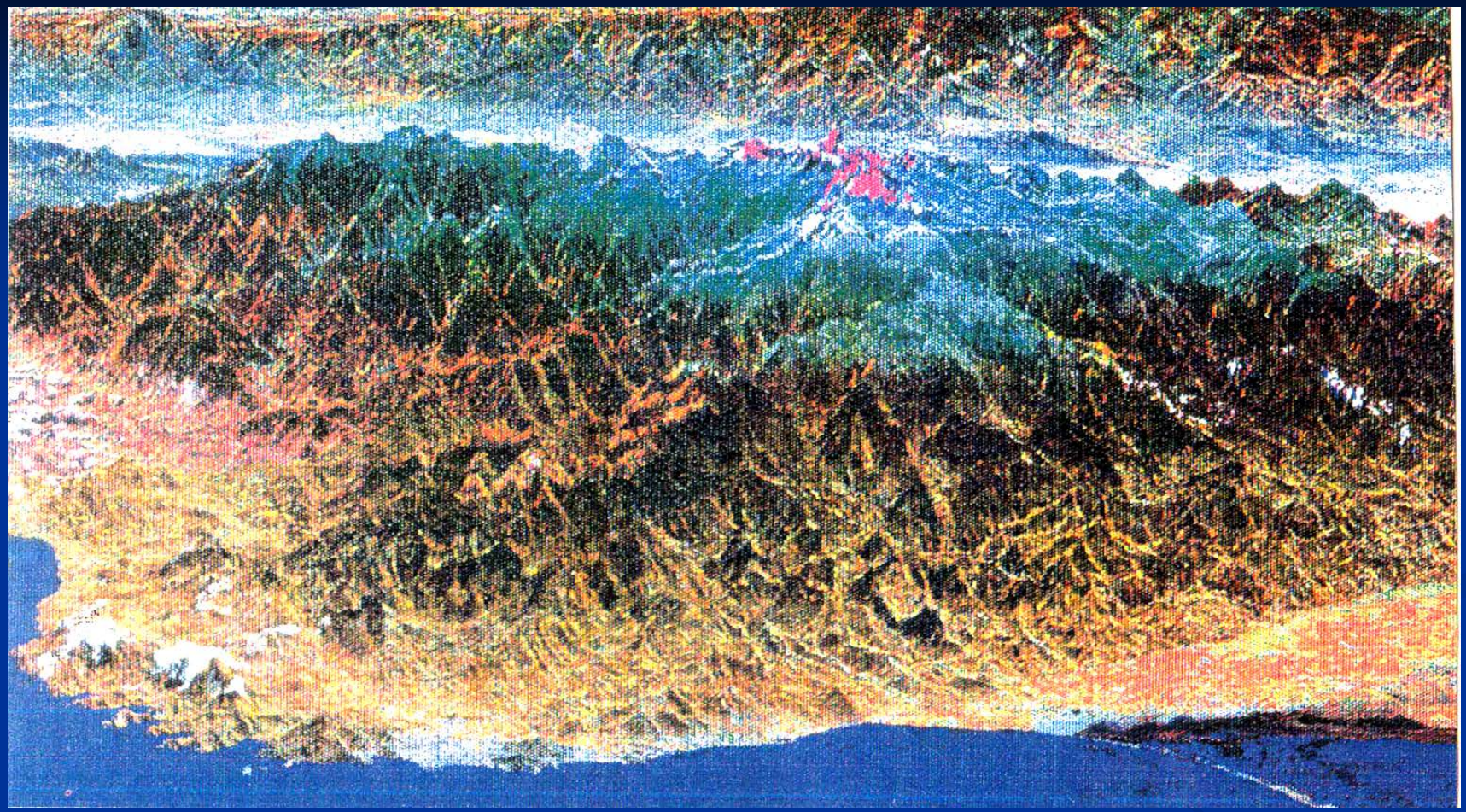


AREA OF STUDY

- Locality
- Ecosystems
- Orogenesis
- Climate



Sierra Nevada of Santa Marta

F.P.S.N.S.M., 1997

THEORETICAL FIELD

- Community Ecology
- Cuantitativism y cualitativism
- Coral Systematics
- Coral Generalities
- General distribution of Coral Communities
- Adaptative and Evolutionary Ecology

Systematics

- **Kingdom ANIMALIA**
- **Sub-kingdom METAZOA**
- **Division EUMETAZOA**
- **Grade RADIATA**
- **Phylum COELENTERATA**
- **Class HIDROZOA**
- **Order MILLEPORINA**
- **Class ANTHOZOA**
- **Subclass ZOANTHARIA o HEXACORALLIA**
- **Order SCLERACTINIA o MADREPORARIA**


Montastrea cavernosa

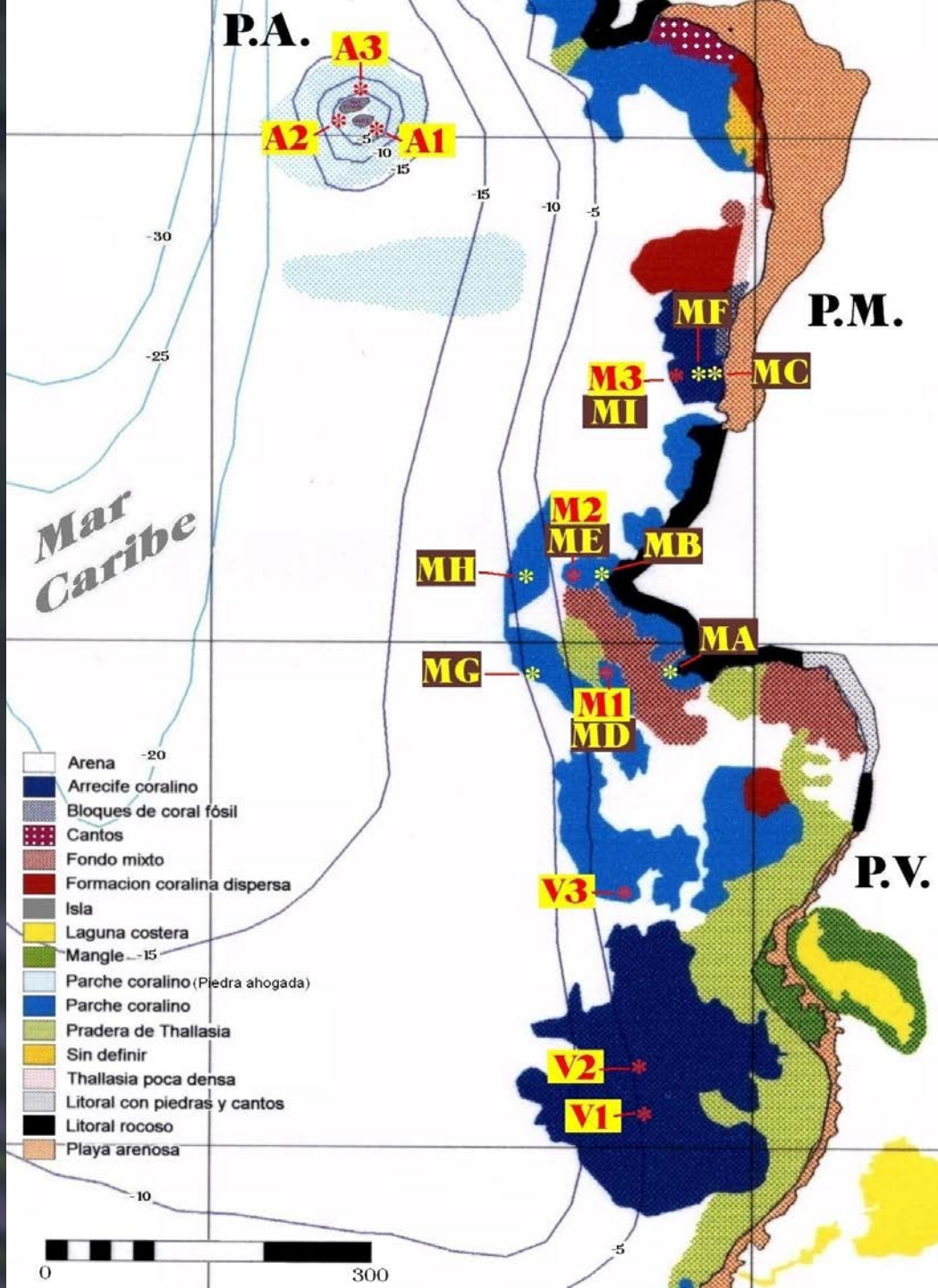
Adaptative and Evolutionary Ecology of Coral Communities

- Climatic stability
- Ecological time
- Intermediate disturbances
- Area
- Spatial heterogeneity
- Species – energy
- Competition – Predation
- "Evolutionary speed"
- Multiple stable states

METHODS

- **Preparation phase**
  - Digitizing maps and aerial photographs
    - Identification of benthic components
  - Delimitation and description of the domain of study
    - Determining stations*
- **Sampling and measuring phase**
  - Determining the cover of the principal benthic components*

Stations


P.A.
A3
A2
A1
P.M.
MF
M3
MC
MI
M2
ME
MB
MH
MA
MG
M1
MD
P.V.
V3
V2
V1
Mar Caribe
-30
-25
-20
-15
-10
-5
Arena
Arrecife coralino
Bloques de coral fósil
Cantos
Fondo mixto
Formacion coralina dispersa
Isla
Laguna costera
Mangle
Parche coralino (Piedra ahogada)
Parche coralino
Pradera de Thallasia
Sin definir
Thallasia poca densa
Litoral con piedras y cantos
Litoral rocoso
Playa arenosa
0
300

Principal benthic components

- **Coral** (i.e. alive, sick and dead)
- **Algae** (i.e. grassy, calcareous, fleshy and encrusting)
- **Sponges** (i.e., free standing and encrusting)
- **Substrates** (i.e. eroded coral, sand, clay, rocks y boulders)

- Calculating phase
  - Determining the quality representation of the sample unit.
  - Spatial-temporal comparison of the percentages of benthic component cover.*
  - Correlation between diversity and depth.*
  - Spatial-temporal comparison of species frequencies.
  - Spatial-temporal comparison of diversity indexes.
  - Description of the similarity and spatial-temporal classification of stations based on live coral cover.*
  - Determination of the spatial arrangement of the dominant coral species.*
  - Representation of the information obtained on a 1:3000 thematic map.

Cover comparison between 1998 and 1999.

- A comparison was made with the sign test of the live coral cover for 1998 and 1999 in front of the Dead Beach zone between the depths of 3.5 and 4.5m.

Correlation of species diversity and depth.

In the 1998 sample of Dead Beach zone the Two-way Spearman correlation test was used to determine if there existed a significant correlation between the organismal diversity and depth.

Saptial-temporal similarity and classification of station.

- Live coral cover data of each species without any transformations.
- Similarity with the Bray – Curtis coefficient.
- Fused dendrogram for contiguous groups of pairs based on the average of the previous group.
- COMM program pack in CLUSTER.
- Two-dimensional principal component analysis (PCA).
- EIGEN values.
- PCA.BAS program pack in ECOLOGY.

Spatial arrangement of dominant coral species.

- With the % of dominant coral species cover per station a series of variances were obtained and plotted over a Cartesian plane.
- Depending on the form of the curve the spatial arrangement of each coral species was determined to be either random, uniform, or grouped.
- The PQV.BAS program pack was used in the program ECOLOGY.

RESULTS I. Dead Beach.

- Quantitative description
  - 1998
  - 1999
  - 1998 versus 1999
- Qualitative description
  - Terrestrial portion
  - Marine portion
- Hurricane Lenny
- Recuperation of Acropora

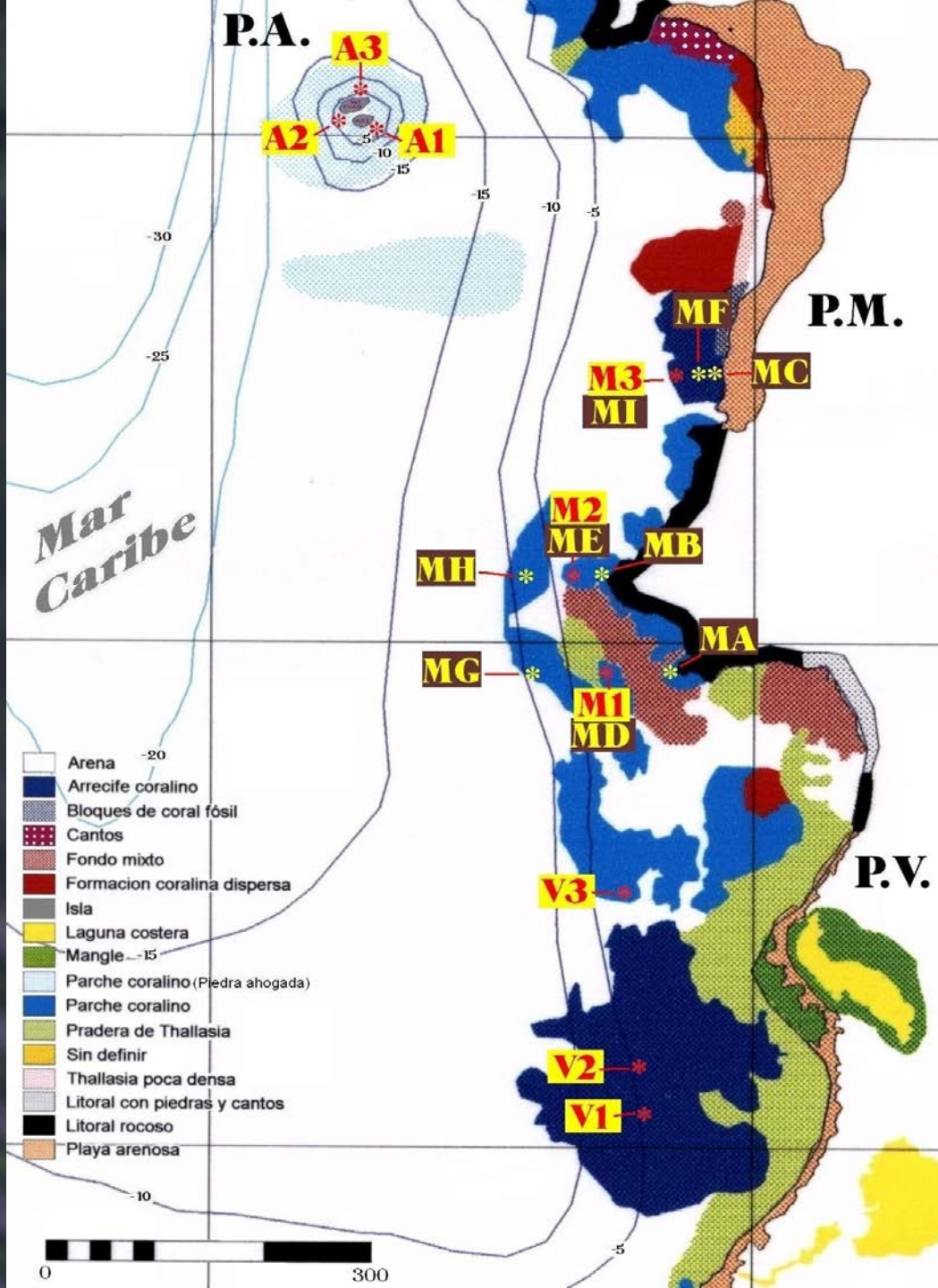
Principal benthic component cover in Dead Beach, 1998

Componente	%	Grado
Sustrato Duro	48.0	1
Coral Erosionado	20.1	
Coral Muerto	18.6	
Roca	5.5	
Canto	3.6	
Sustrato Blando (Arena)	29.3	2
*Algas	27.4	3
Cespitosas	21.7	
Calcáreas	0.9	
Incrustantes	0.8	
Carnosas	0.6	
Coral Vivo	18.1	4
Otros	3.6	5
Esponjas Erectas	0.8	6
*Esponjas Incrustantes	0.7	7

Coral species statistics for Dead Beach, 1998

ESPECIES	% CORAL VIVO (C.V.)	RANGO % C.V.	FRECUENCIA C.V. (%)	% CORAL ENFERMO	% CORAL MUERTO
Millepora complanata	26.2	11.2 – 62.1	100	0.6	10.5
M. alcicornis	1.6	0.0 – 9.7	52	0.0	1.4
Diploria clivosa	1.8	0.0 – 14.9	31	5.1	0.0
D. strigosa	19.9	0.0 – 59.5	88	1.2	15.6
D. labyrinthiformis	5.3	0.0 – 23.4	65	1.1	0.6
Siderastrea siderea	5.8	0.0 – 40.2	83	17.4	11.4
S. radians	9.6	0.0 – 58.1	53	0.0	31.4
Montastrea annularis	3.3	0.0 – 13.2	33	0.0	13.7
M. cavernosa	2.5	0.0 – 17.7	35	5.8	16.8
M. faveolata	1.3	0.0 – 12.6	6	0.0	0.0
Agaricia agaricetes	0.4	0.0 – 4.4	17	0.0	0.0
Acropora palmata	10.1	0.0 – 65.1	19	0.0	88.7
A. cervicornis	1.3	0.0 – 11.4	13	0.0	95.9
Manicina areolata	0.4	0.0 – 4.5	12	21.4	0.0
Colpophyllia natans	7.3	0.0 – 66.7	58	0.0	7.0
Dichocoenia stokesii	0.1	0.0 – 1.6	12	40.0	33.3
Porites astreoides	2.0	0.0 – 7.1	72	2.4	1.7
Solenastrea sp.	0.9	0.0 – 11.4	12	0.0	0.0
Meandrina meandrites	0.3	0.0 – 5.9	6	0.0	0.0

Stations


P.A.
A3
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V3
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Mar Caribe
-30
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-15
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Arena
Arrecife coralino
Bloques de coral fósil
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Fondo mixto
Formacion coralina dispersa
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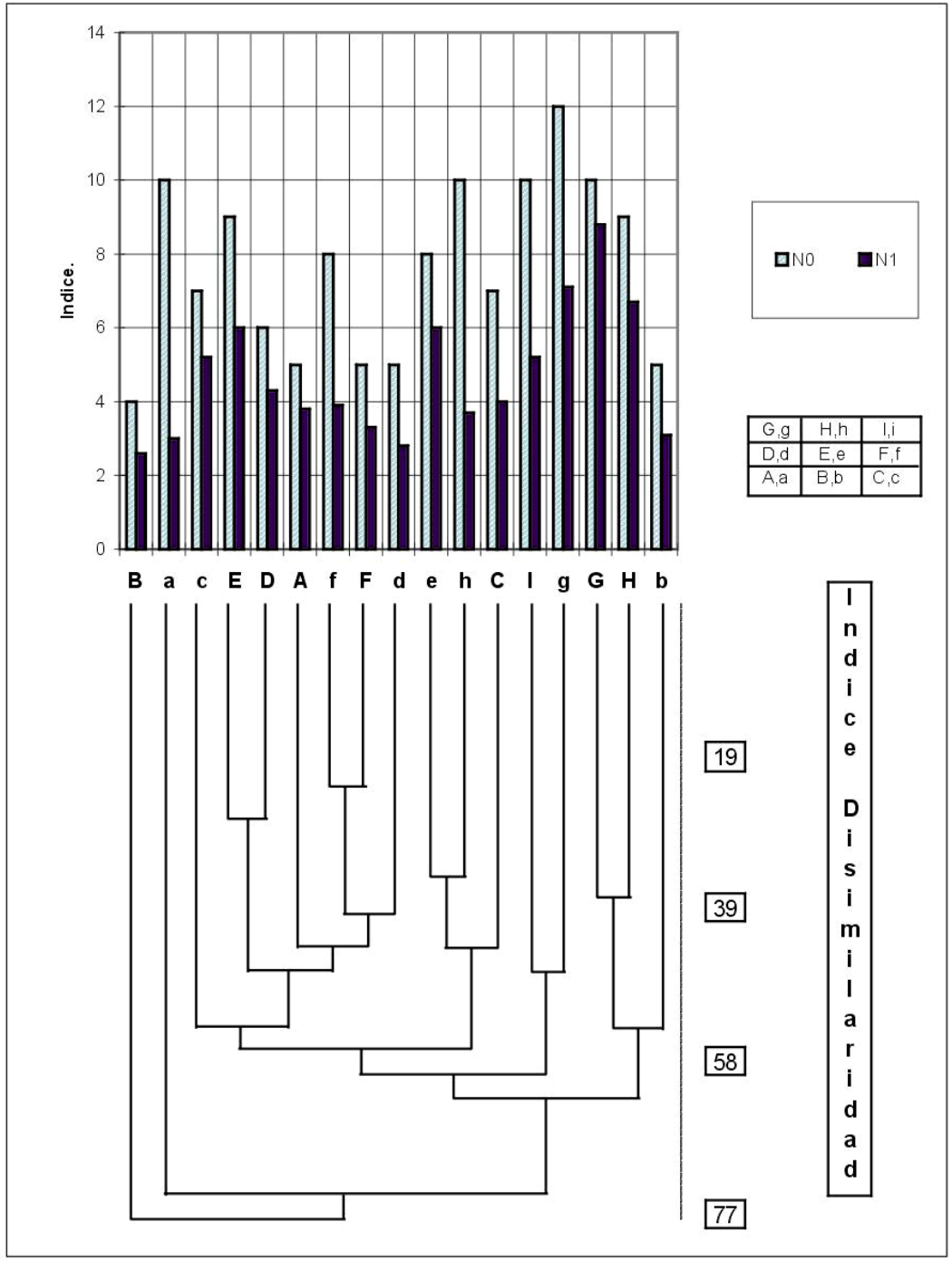
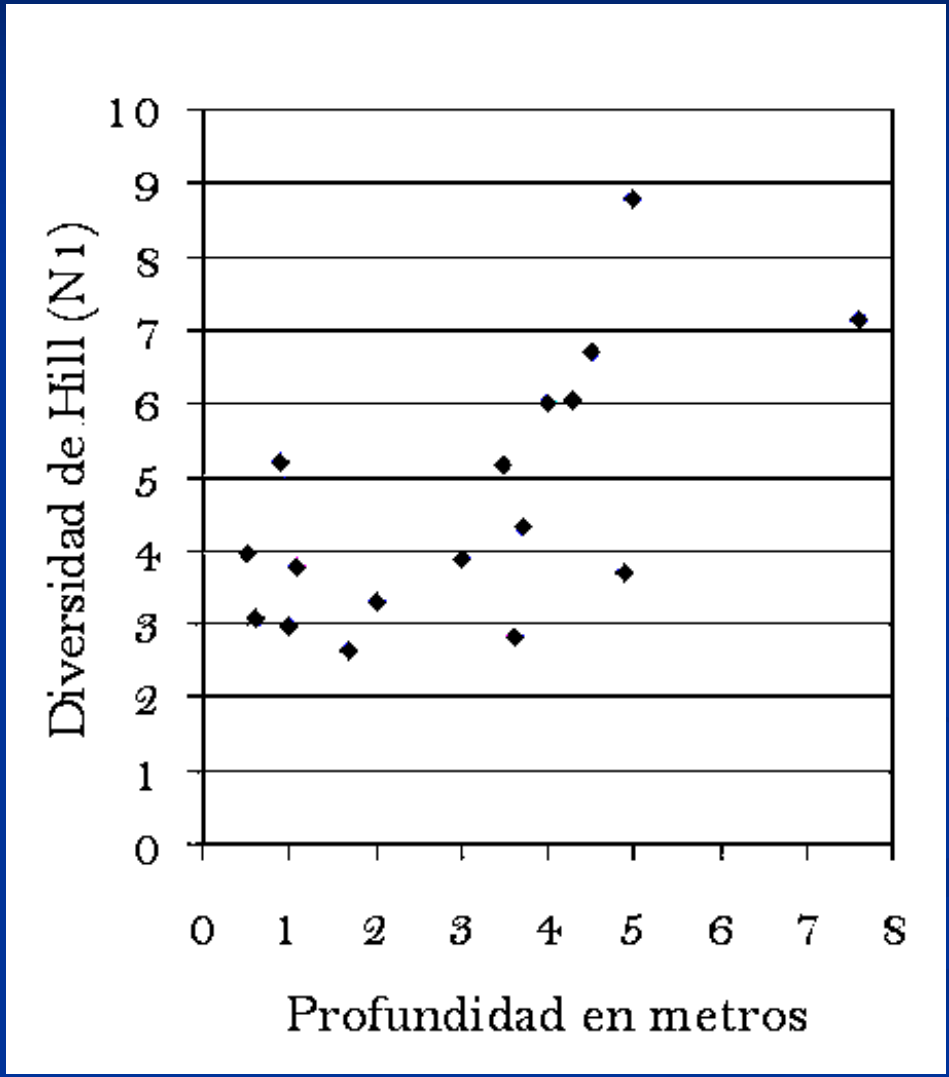
Parche coralino
Pradera de Thallasia
Sin definir
Thallasia poca densa
Litoral con piedras y cantos
Litoral rocoso
Playa arenosa
0
300

Simila Dead

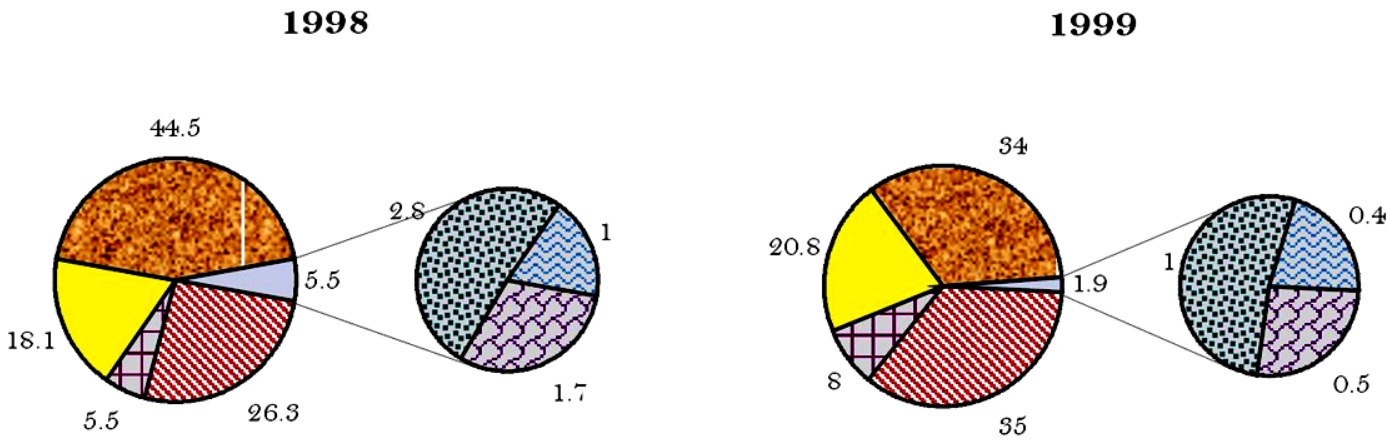

14
12
10
8
6
4
2
0
Indice.
N0
N1
G,g
H,h
I,i
D,d
E,e
F,f
A,a
B,b
C,c
B a c E D A f F d e h C I g G H b
19
39
58
77
Indice Disimilaridad

Depth and diversity in Dead Beach, 1998



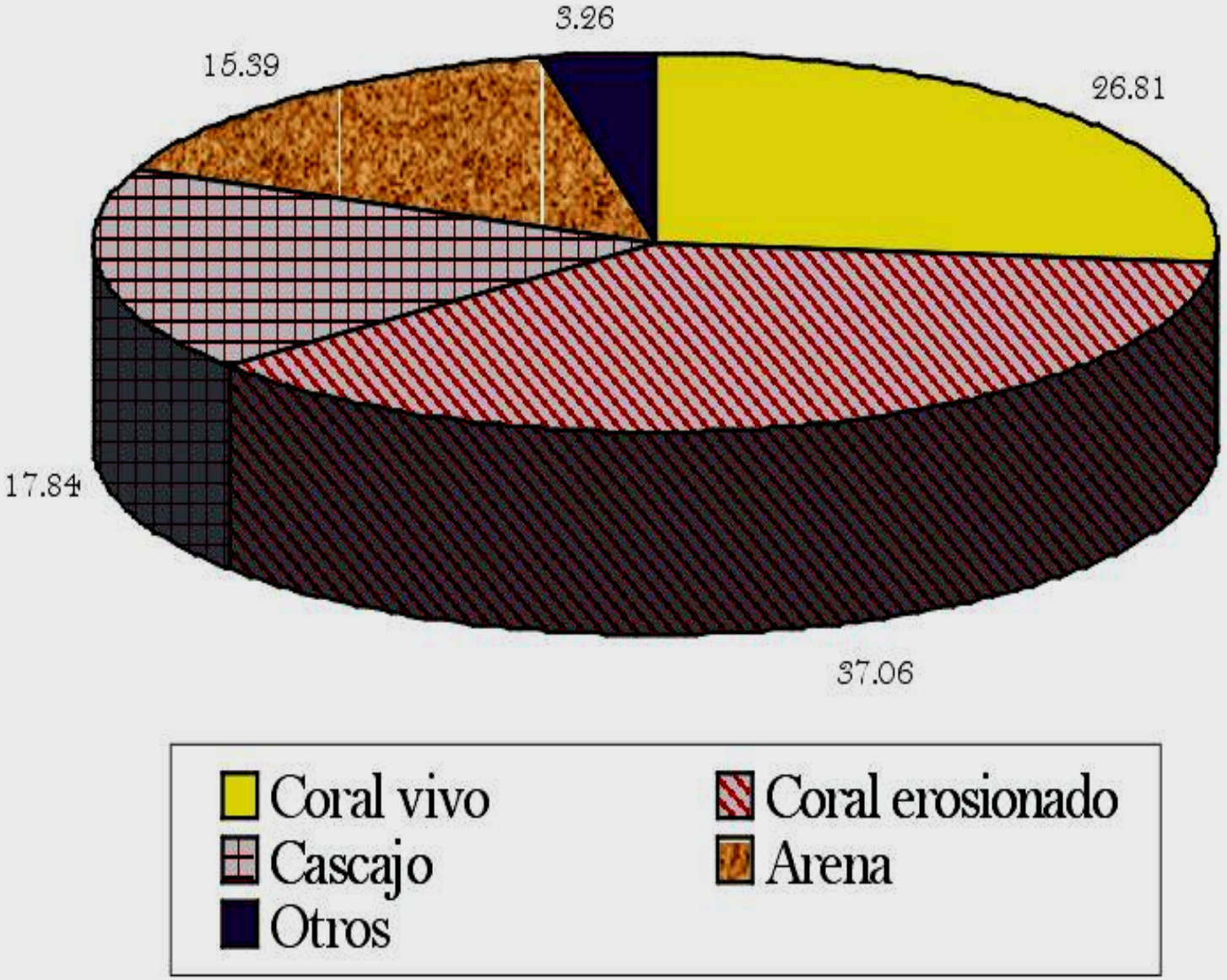
Cobertura para 1998 y 1999 en P.M. entre los 3.5 y 4.5m

- Coral erosionado.
- Cascajo.
- Coral vivo.
- Arena.
- Esponjas erectas.
- Coral muerto.
- Otros.



RESULTS II. Domain and Zones.

Principal benthic component cover in the domain, 1999

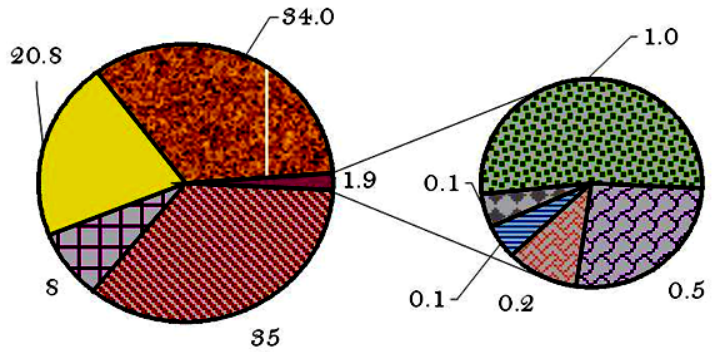


Coral species statistics for the domain, 1999

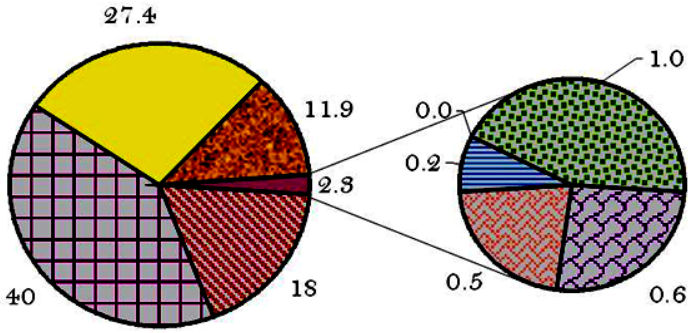
ESPECIES	% CORAL VIVO (C.V.)	RANGO % C.V.	FRECUENCIA C.V. (%)	NUMERO COLONIAS	% CORAL ENFERMO	% CORAL MUERTO
Millepora complanata	28.8	8.4 – 50.5	100.0	N/A	0.0	0.2
M. alcicornis	1.3	0.0 – 11.8	77.8	N/A	0.0	0.0
Diploria clivosa	1.5	0.0 – 4.9	77.8	16	0.0	3.6
D. strigosa	11.6	1.8 – 47.2	100.0	102	1.0	3.8
D. labyrinthiformis	2.4	0.6 – 5.8	100.0	19	2.2	2.2
Siderastrea siderea	22.8	0.0 – 57.0	88.9	86	4.2	1.9
S. radians	0.4	0.0 – 1.9	44.4	12	25.0	0.0
Montastrea annularis	4.1	0.0 – 15.5	55.6	16	24.8	9.6
M. cavernosa	4.9	0.0 – 28.8	77.8	42	0.0	11.6
M. faveolata	1.4	0.0 – 9.6	11.1	6	10.7	15.2
Agaricia humilis	2.0	0.0 – 7.4	66.7	74	5.3	2.6
A. tenuifolia	0.3	0.0 – 1.3	33.3	6	0.0	0.0
A. spp.	0.3	0.0 – 1.3	44.4	7	0.0	0.0
Acropora palmata	0.3	0.0 – 2.8	11.1	1	0.0	0.0
A. cervicornis	0.3	0.0 – 5.9	11.1	2	0.0	40.0
Manicina areolata	0.4	0.0 – 4.9	33.3	10	0.0	12.5
Colpophyllia natans	8.9	0.0 – 46.2	44.4	27	0.7	4.4
Dichocoenia stokesii	0.01	0.0 – 0.3	11.1	2	0.0	0.0
Porites astreoides	5.1	1.2 – 14.8	100.0	160	1.9	5.3
Favia fragum	0.6	0.0 – 2.2	33.3	29	6.3	0.0
Meandrina meandrites	1.1	0.0 – 4.4	55.6	12	0.0	14.3
Leptoseris cucullata	0.4	0.0 – 1.5	44.4	9	0.0	0.0
Stephanocoenia intercepta	0.4	0.0 – 1.9	55.6	7	0.0	0.0
Madracis decactis	0.4	0.0 – 5.9	22.2	3	0.0	12.5

Coverage by zones, 1999

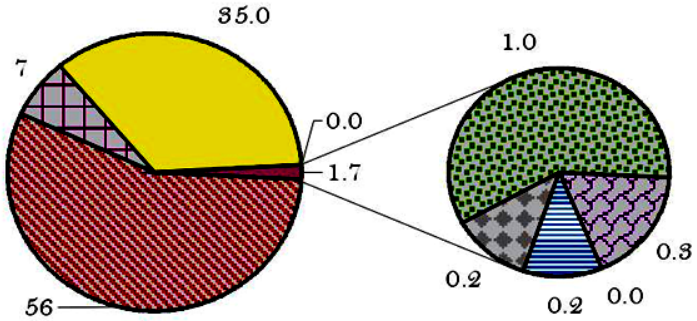
Playa del muerto.



Playa viva.

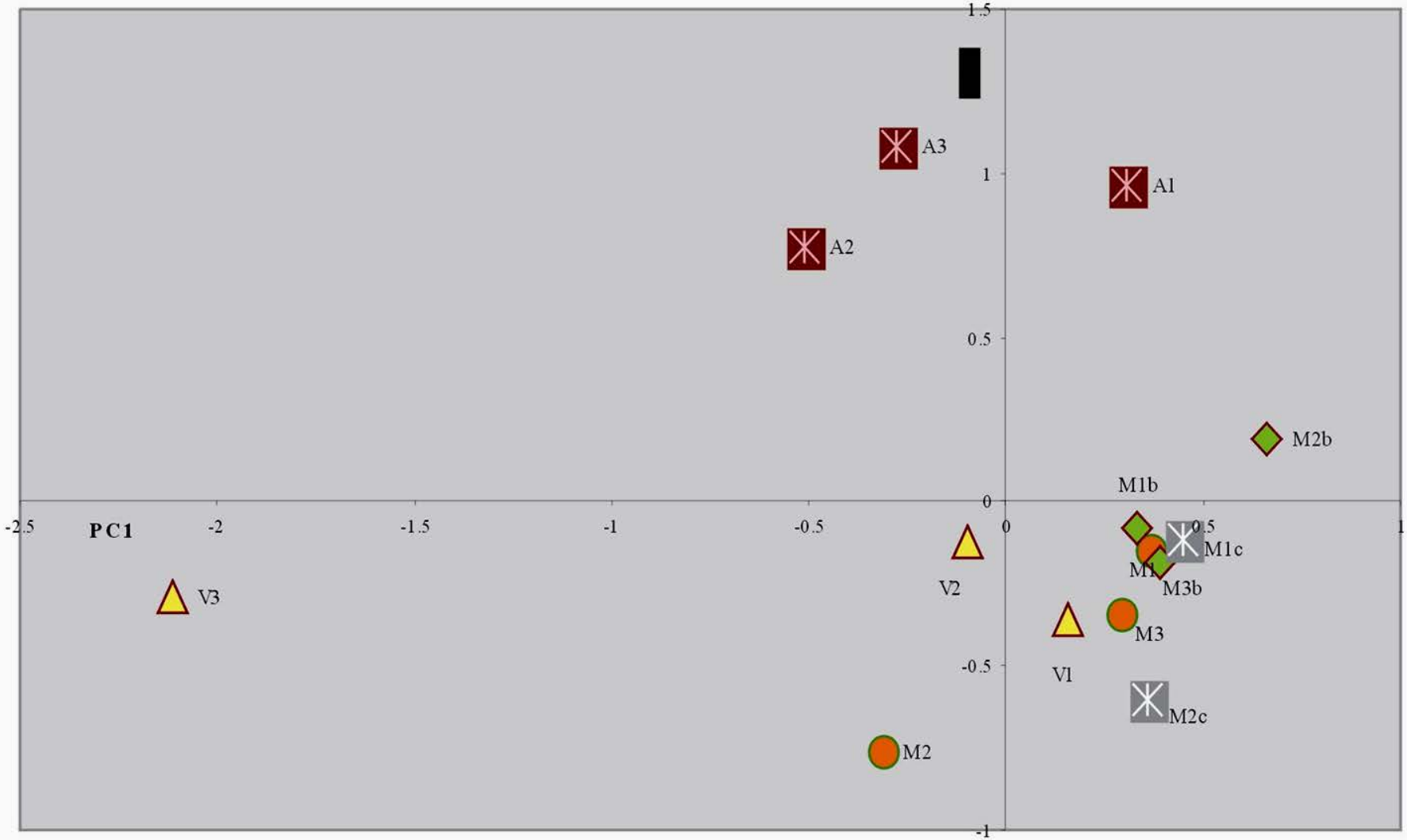


Piedra ahogada.

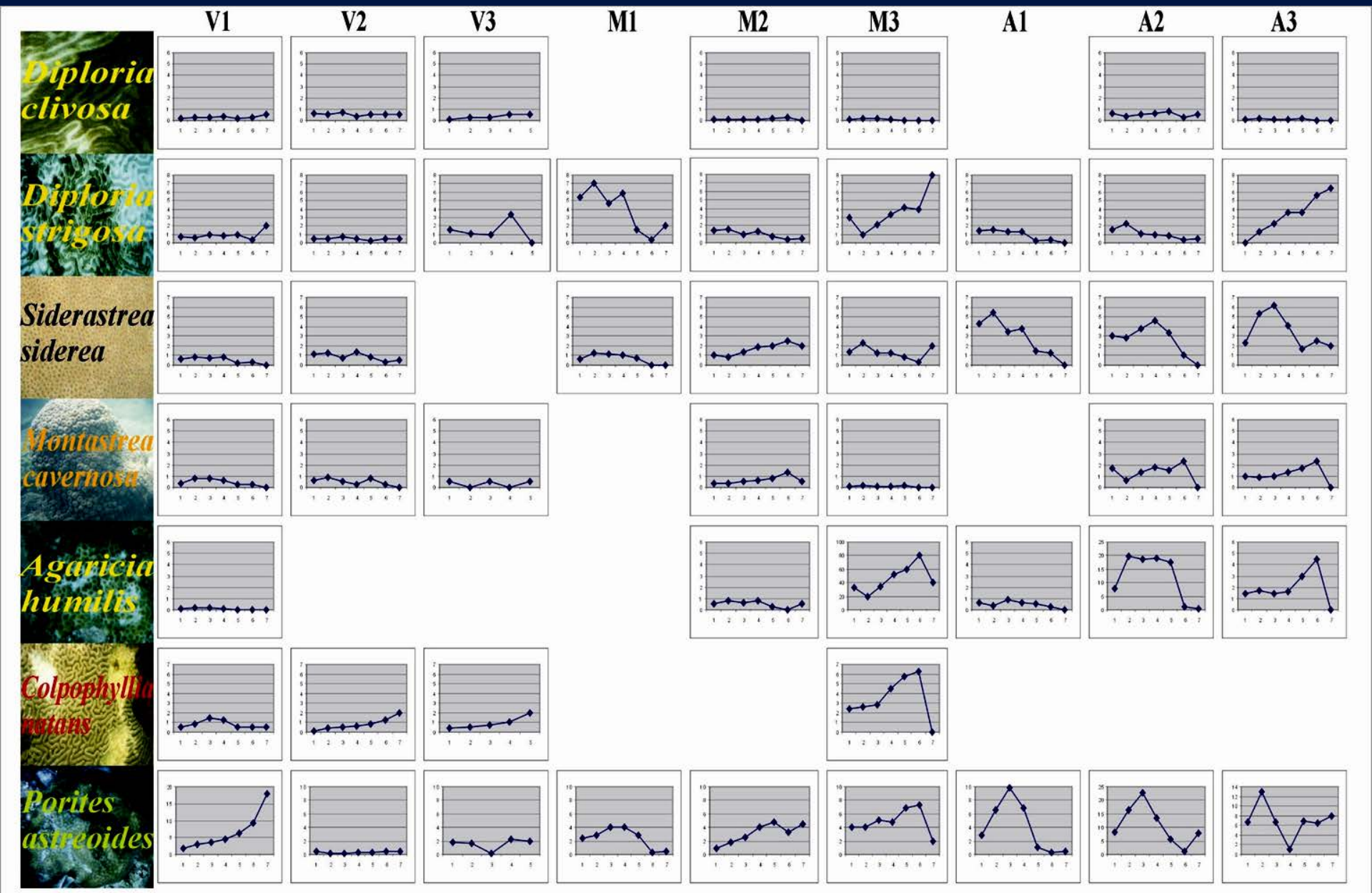


- Coral erosionado.
- Cascajo.
- Coral vivo.
- Arena.
- Esponjas erectas.
- Anemonas.
- Palythoa.
- Gorgonaceos.
- Coral muerto.

PCA for 1998 and 1999 between 3.5 and 4.5m (PC1 y PC2 with a 41.6% variation)



PQV


V1
V2
V3
M1
M2
M3
A1
A2
A3
Diploria clivosa
Diploria strigosa
Siderastrea siderea
Montastrea cavernosa
Agaricia humilis
Colpophyllia natans
Porites astreoides

RESULTS III. 1976, 1987 y 1999 Species richness.

1976, 1987 y 1999 Species richness

ESPECIES	1976 P.V.	1987 Total	1999 Total	1998 P.M.	1999 P.M.	1999 P.V.	1999 P.A.
Acropora cervicornis	X	X	X	X		1.0	
Acropora palmata	X	X	X	1.2	X	1.0	X
Agaricia agaricetes	X	X	X	1.0			
Agaricia fragilis			X			X	
Agaricia humilis			X		3.7	0.2	2.1
Agaricia lamarcki	X						
Agaricia spp.			X			0.3	0.5
Agaricia tenuifolia	X	X	X			0.3	0.5
Astrangia solitaria	X	X					
Cladocora arbuscula	X	X	X			X	
Colpophyllia amaranthus	X	X					
Colpophyllia breviserialis	X						
Colpophyllia natans	X		X	10.1	4.3	22.4	
Dichocoenia stokesii	X		X	0.1	X		0.1
Diploria clivosa	X	X	X	X	1.0	2.8	0.7
Diploria labyrinthiformis	X	X	X	5.4	2.5	2.8	2.0
Diploria strigosa	X	X	X	30.9	20.6	6.4	7.9
Eusmilia fastigiata	X						
Favia fragum	X	X	X	X			1.8
Isophyllia sinuosa	X						
Leptoseris cucullata	X	X	X		0.2	0.2	0.7
Madracis decactis	X		X			1.0	0.1
Madracis formosa			X			X	
Madracis mirabilis	X	X	X			X	
Madracis pharensis	X		X				
Manicina areolata	X	X	X	X	0.2	1.0	X
Meandrina meandrites	X	X	X	1.5	2.7	0.2	0.5
Millepora alcicornis	X	X	X	0.6	0.4	2.9	0.7
Millepora complanata	X	X	X	29.8	43.6	28.6	14.1
Millepora squarrosa	X	X					
Montastrea annularis	X	X	X	4.2	2.9	2.4	7.0
Montastrea cavernosa	X	X	X	3.5	7.0	5.7	2.2
Montastrea faveolata			X	X		4.3	
Mussa angulosa	X	X					
Mycetophyllia ferox	X		X				X
Mycetophyllia lamarckana	X	X					
Mycetopyllia aliciae			X			X	
Oculina diffusa	X	X	X	X	X		
Phylangia americana	X	X					
Porites astreoides	X	X	X	2.2	3.7	3.1	8.5
Porites porites	X	X	X			X	
Scolymia lacera	X	X					
Scolymia spp.			X			X	
Siderastrea radians	X		X	3.4	0.6	X	0.7
Siderastrea siderea	X	X	X	6.6	6.0	12.6	49.8
Solenastrea hyades	X		X		X		X
Solenastrea bournoni			X	X	X		
Stephanocoenia michelinii		X					
Stephanocoenia intersepta	X	X	X		0.6	0.7	
Tubastre aurea		X					
ESPECIES TOTALES:	40	31	37	21(14)	21(16)	29(21)	22(18)

ANALYSIS OF RESULTS

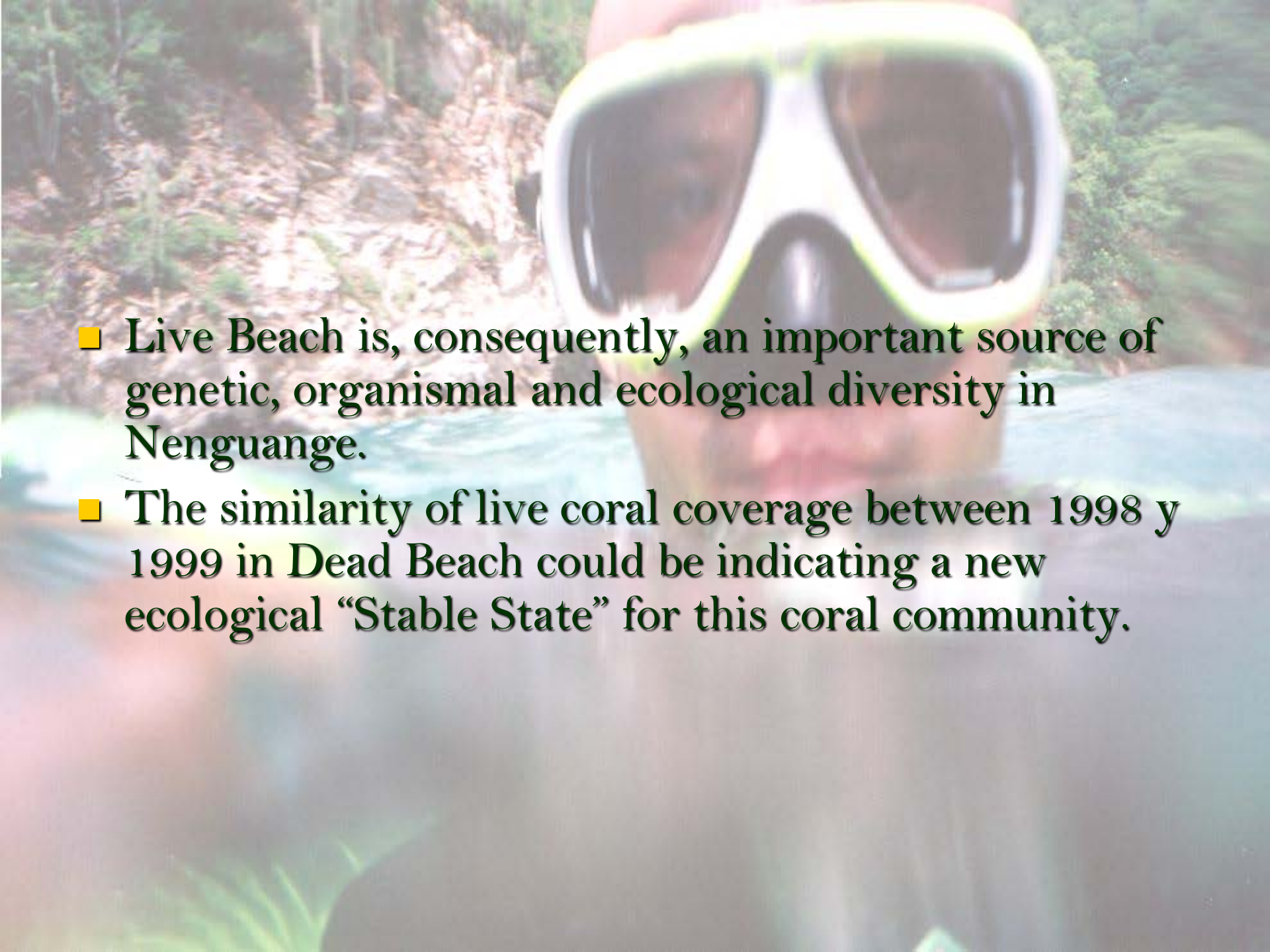
- Anthropic history.
- Erosion: the link between land and sea.
- The trail by foot.
- The coral community.
- Flora and fauna.
- Coral health.
- Possible signs of recuperation.
- Perturbing agents.
- Planning tools.

CONCLUSIONS

- Sedimentation caused by surface run-off is still affecting the community since the last study made 25 years ago as evidenced by the whitening of *Montastrea annularis.*
- The mangrove forest showed signs of heavy impact from man-made forces such as garbage and compacting of sediment by foot.
- The coral formations found are *fringing reefs* and *coral heads.*
- The reef is an *Acropora – Diploria* type reef with intermediate water currents.
- There exists large variations in the composition of the reef within very small areas.

- Live coral coverage was 26.8% relative to the sea floor and 32.7% relative to the hard substrate. This is characteristic of many other parts of the world where important reef formations have been described (i.e. the Caribbean, Middle East and Indonesia).
- 37 Scleractinian coral species were found of a possible 50 since studies began in the Bay. 650 colonies in total were studied.
- *Millepora complanata*, *Siderastrea siderea*, *Diploria strigosa* and *Colpophyllia natans* dominated the live coral coverage.
- *Porites astreoides* and *Agaricia humilis* had little coverage but dominated in number of colonies and frequency throughout the domain.

- Of the 37 species of coral found, 7 were new reports for the Bay.
- 10 species presented bleaching or the dark band disease, especially the species *Siderastrea siderea* and *Montastrea annularis.*
- For the first time since the decline of Acropora new colonies were found growing especially in Live Beach coinciding with the closing of the Park to turism.
- The differences in coral coverage, species richness and diversity between zones can be attributed to the heterogeneity of the niches and the differences in hard substrate availability in each zone.



- Live Beach is, consequently, an important source of genetic, organismal and ecological diversity in Nenguange.
- The similarity of live coral coverage between 1998 y 1999 in Dead Beach could be indicating a new ecological “Stable State” for this coral community.

FIN

Characterization of a Coral Community

Mauricio González

maougon@yahoo.com