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# Coastal Monitoring in the Mexican Gulf of Mexico. A Regional Experience and Proposal

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Gulf of Mexico Large Marine Ecosystem Project

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Cinvestav Merida

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# Coauthors

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- .- Jorge Herrera-Silviera
  - .- Omar Zapata-Pérez
  - .- Leopoldina Aguirre-Macedo
  - .- Victor Vidal-Marinez
  - .- Pedro Ardisson
- .. . . and a long list of students and technicians

# Background

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- The Mexican state of Yucatan decided to do the Ecological Land Use Plan for the state
  - A subcomponent is the plan for the coast
    - In Mexico the coast is under federal jurisdiction
    - An agreement has to be made
- There was very little information on the status of coastal ecosystems
  - No diagnosis

# Study Zone

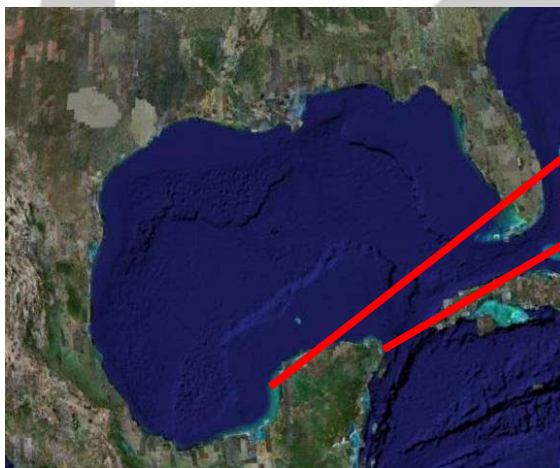


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Coast of Yucatan  
~ 350 km

No rivers or lakes

Only groundwater flow  
 $12 - 16 \times 10^6 \text{ m}^3/\text{km}/\text{y}$



Merida

Cancun

# Study Zone . . .



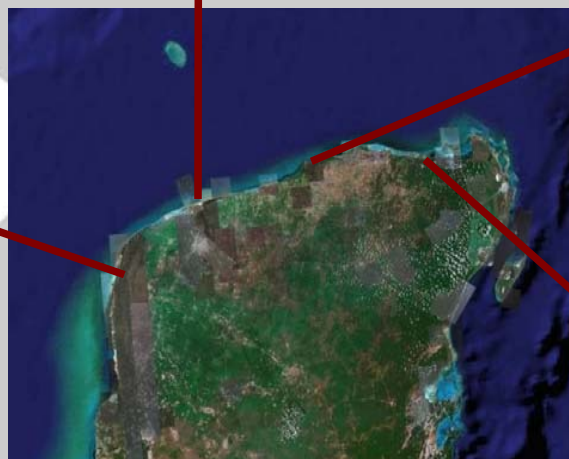
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Chelem



Dzilam

Rio Lagartos



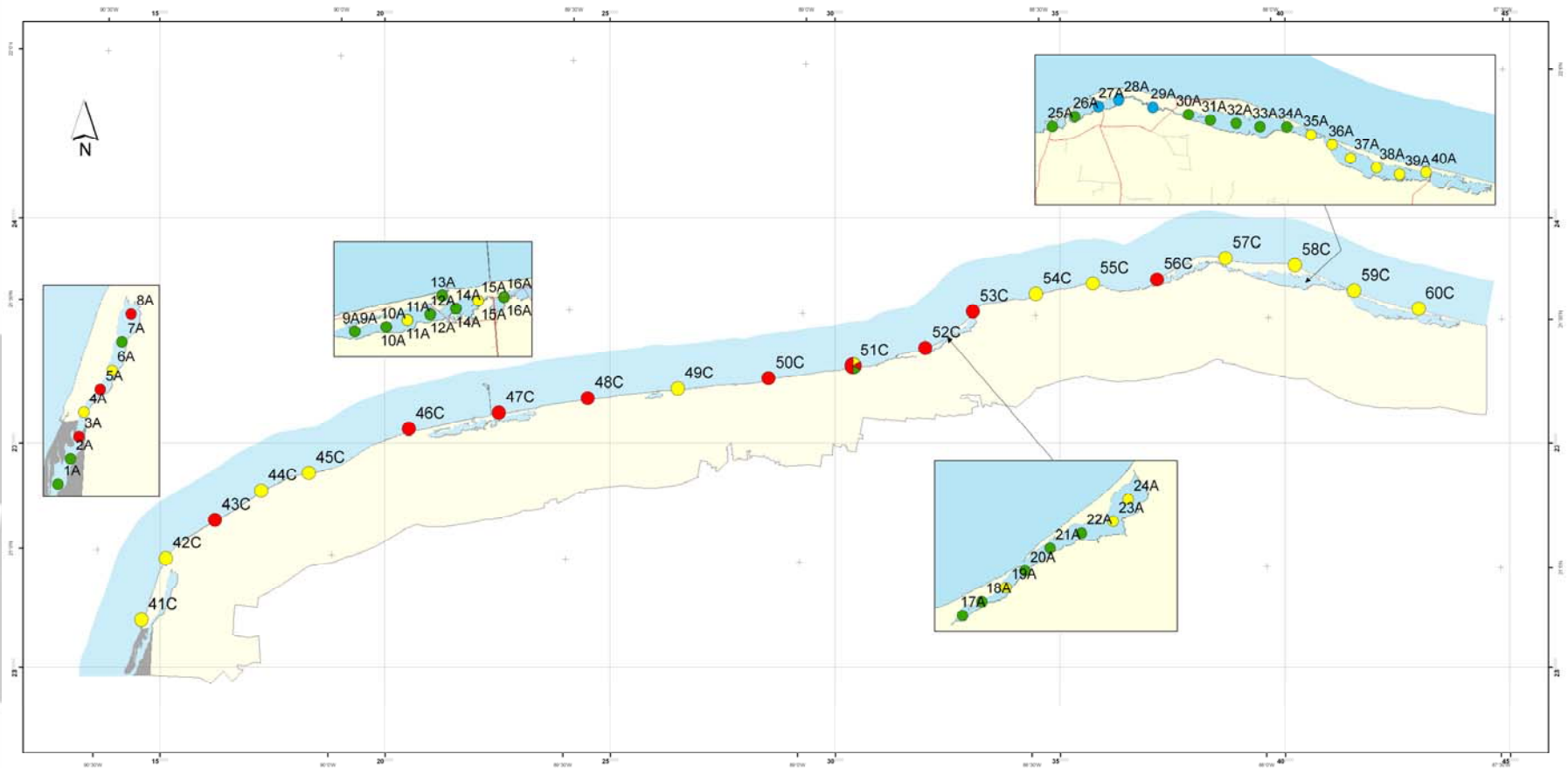
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# Sampling Design



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Samples were collected in 100 stations  
40 in coastal lagoons  
20 in the coastal zone (at 3 distances from the coast)

# Approach



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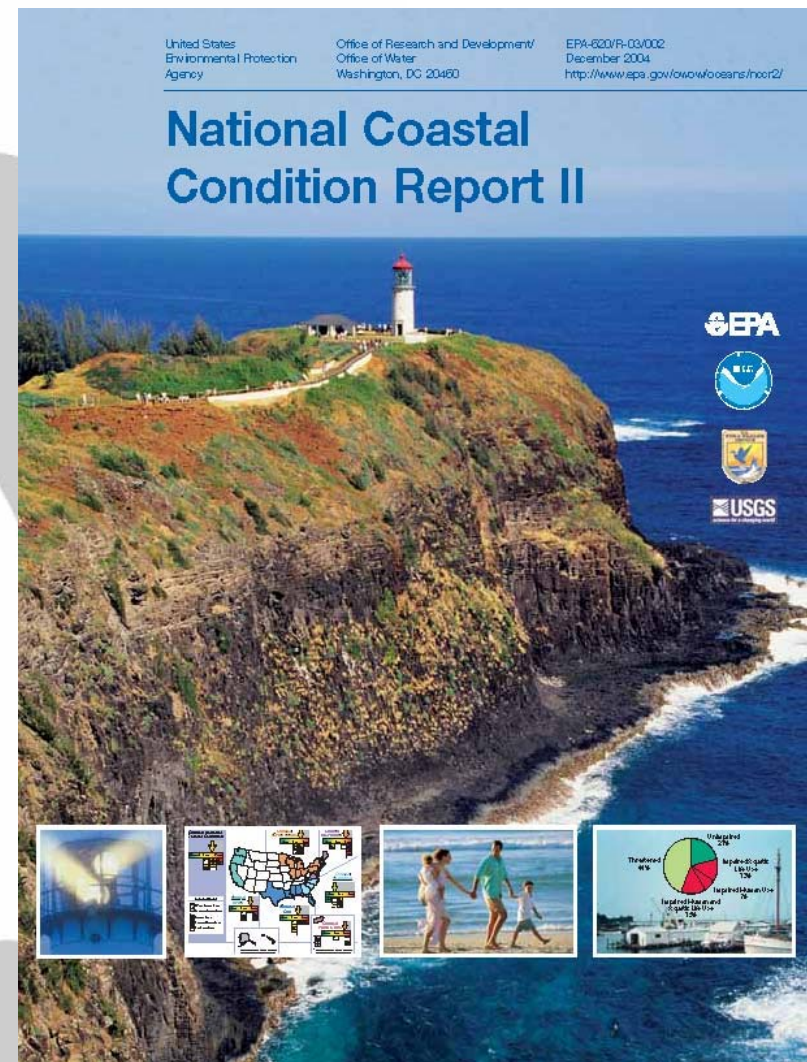
- There were five major components:
  - Water Quality
    - Dr. Jorge Herrera, Primary Productivity Lab
  - Sediment Quality
    - Dr. Gerardo Gold, Marine Geochemistry Lab
  - Benthos
    - Dr. Pedro Ardisson, Benthic Ecology Lab
  - Fish Health
    - Dr. Omar Zapata, Ecotoxicology Lab and Drs. Leopoldina Aguirre and Víctor Vidal, Aquatic Pathology Lab
  - Habitat Alteration
    - Dra. Ana García, Cartografic Analysis Lab

# Approach . . .



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- For data analysis
- Similar to the National Coastal Condition  
– With some modifications





# Water Quality



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- Considers water concentrations of:
  - Nitrates, nitrites, ammonium, phosphates, silicates, chlorophylls, dissolved oxygen, etc.
  - It is summarized in the “TRIX Index”

Vollenweider RA, Giovanardi F, Montanari G, et al.  
1998. *Environmetrics* 9 (3): 329-357

# Sediment Quality



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- Considers sediment concentrations of:
  - PAHs
  - Organochlorine Pesticides
  - PCBs
  - Metals were not analyzed
- Concentrations are compared to Sediment Quality Guidelines:
  - TEL (Threshold Effects Level)
  - PEL (Probable Effects Level)

# Benthos



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- Based on abundance, diversity and evenness of selected taxa from the macrobenthos:
  - Adenophora (Nematoda)
  - Sylliidae (Polychaeta)
  - Opheliidae (Polychaeta)
  - Ostracoda (Crustacea)
  - Amphipoda (Crustacea)
  - Copepoda (Crustacea)

# Fish Health



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- Based on two types of indicators:
- Pathology
  - Histopathology
  - Gonadosomatic Index
  - Condition Index
- Biomarkers
  - *O'*-Etoxyresorufin deetilase (EROD) activity
  - Catalase Activity
  - CYP-450 protein

*Sphaeroides testudineus*



# Habitat Alteration



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- Based on the rate of loss of coastal wetlands in the period 1990-2000
  - Coastal erosion
  - Mangrove deforestation
- It is being processed and updated

# Categorización



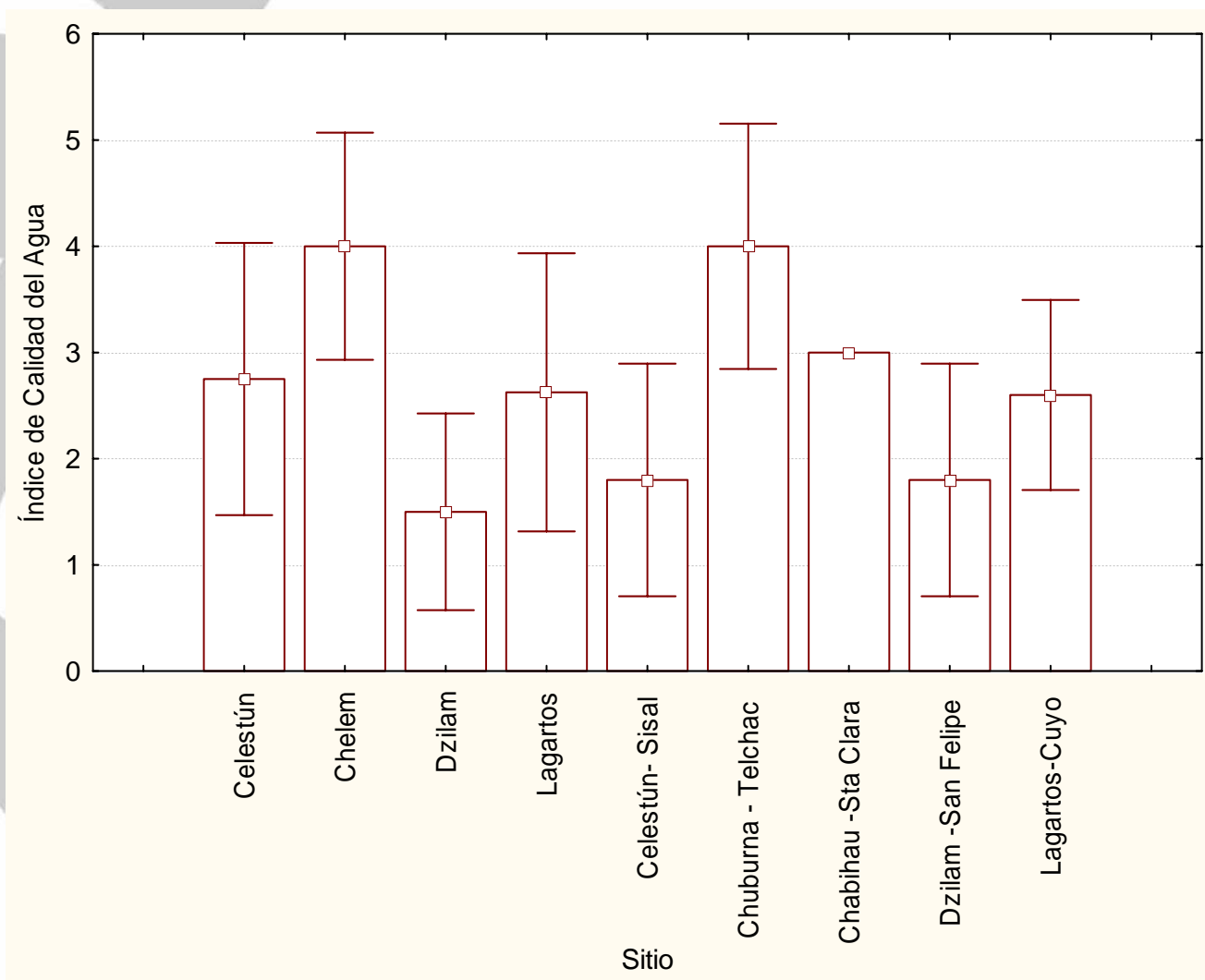
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- According to pre-established criteria, each collaborator categorized results:
  - Good (1)
  - Regular (3)
  - Bad (5)
- To calculate the global index the average was calculated

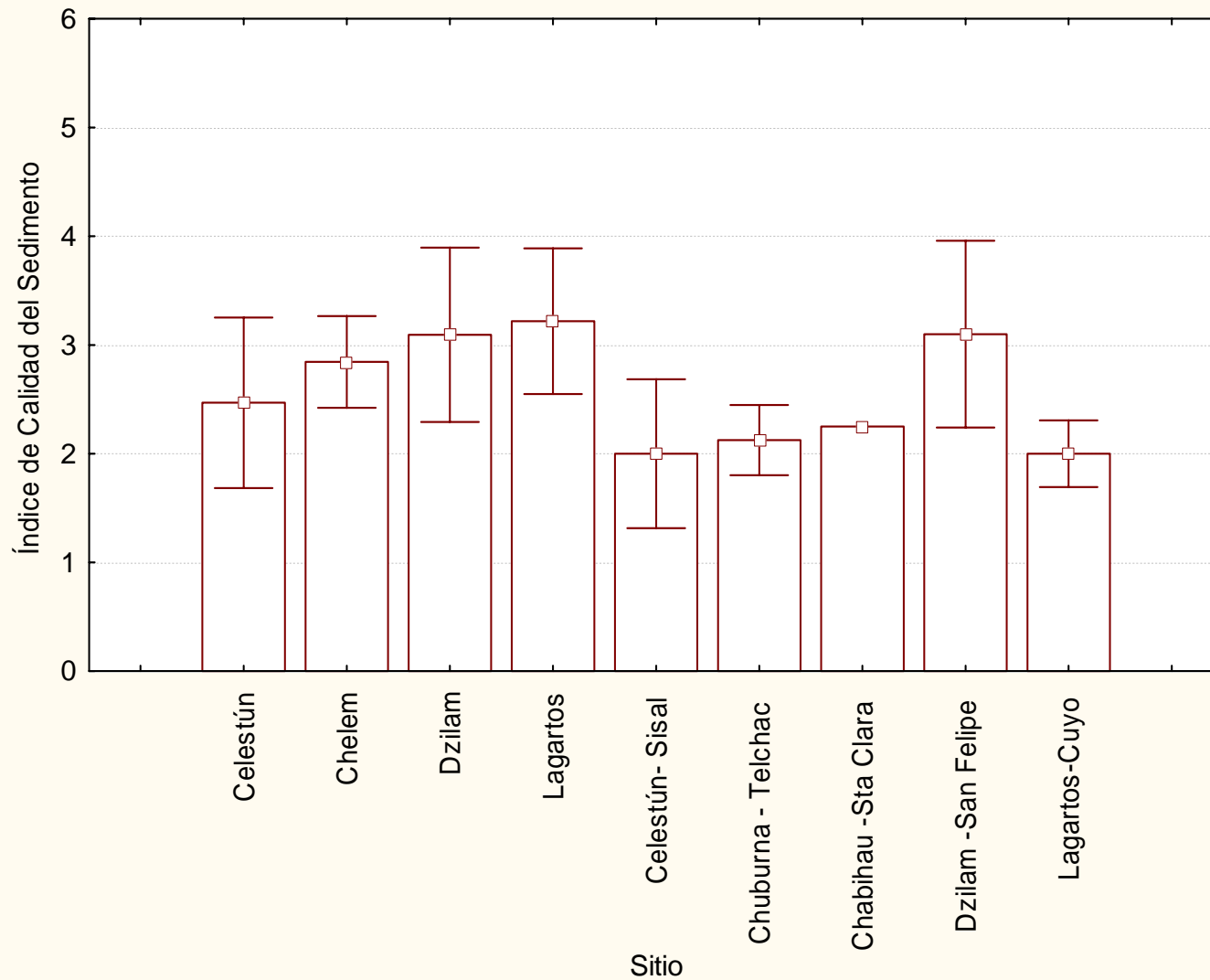
# Water Quality



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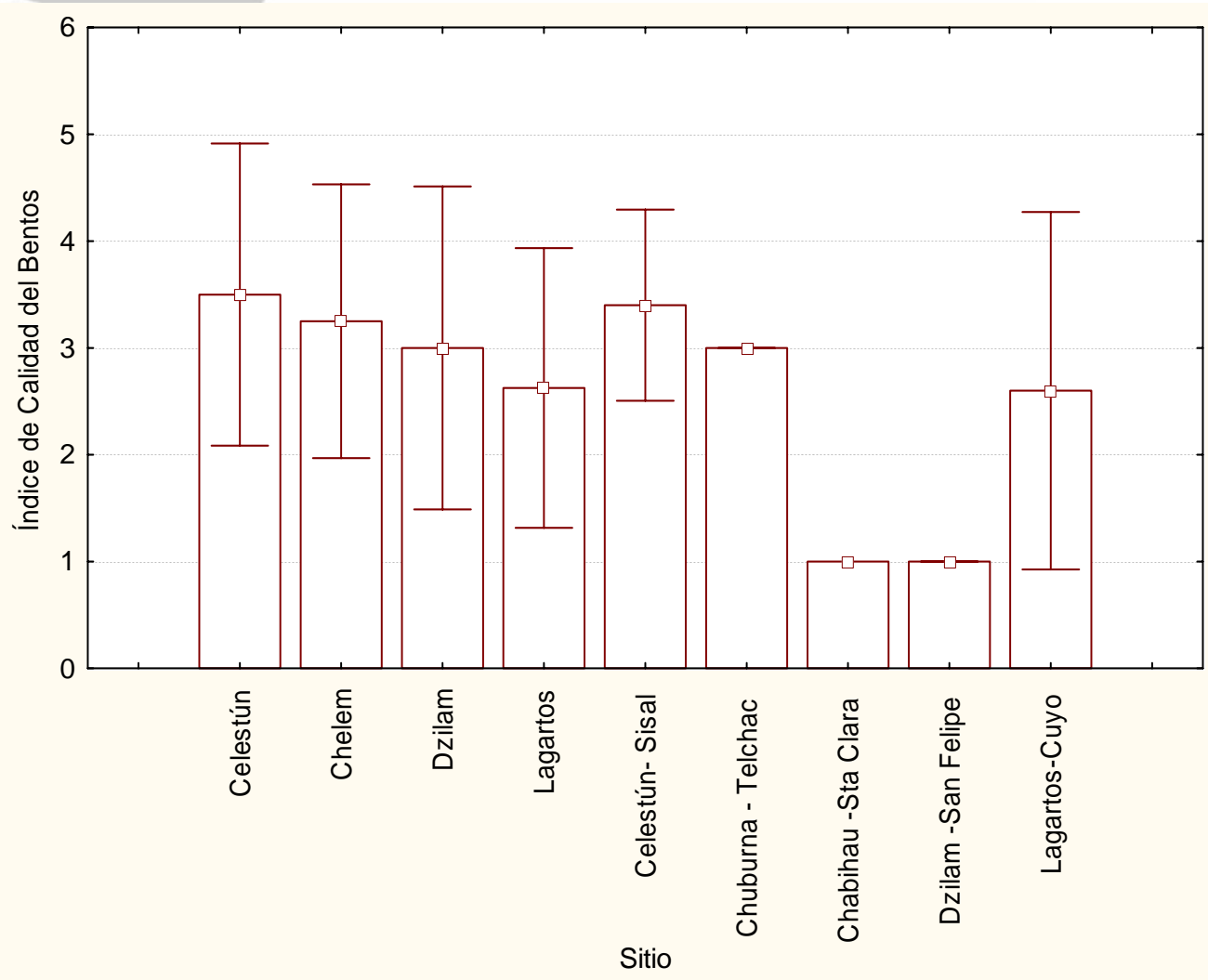


# Sediment Quality





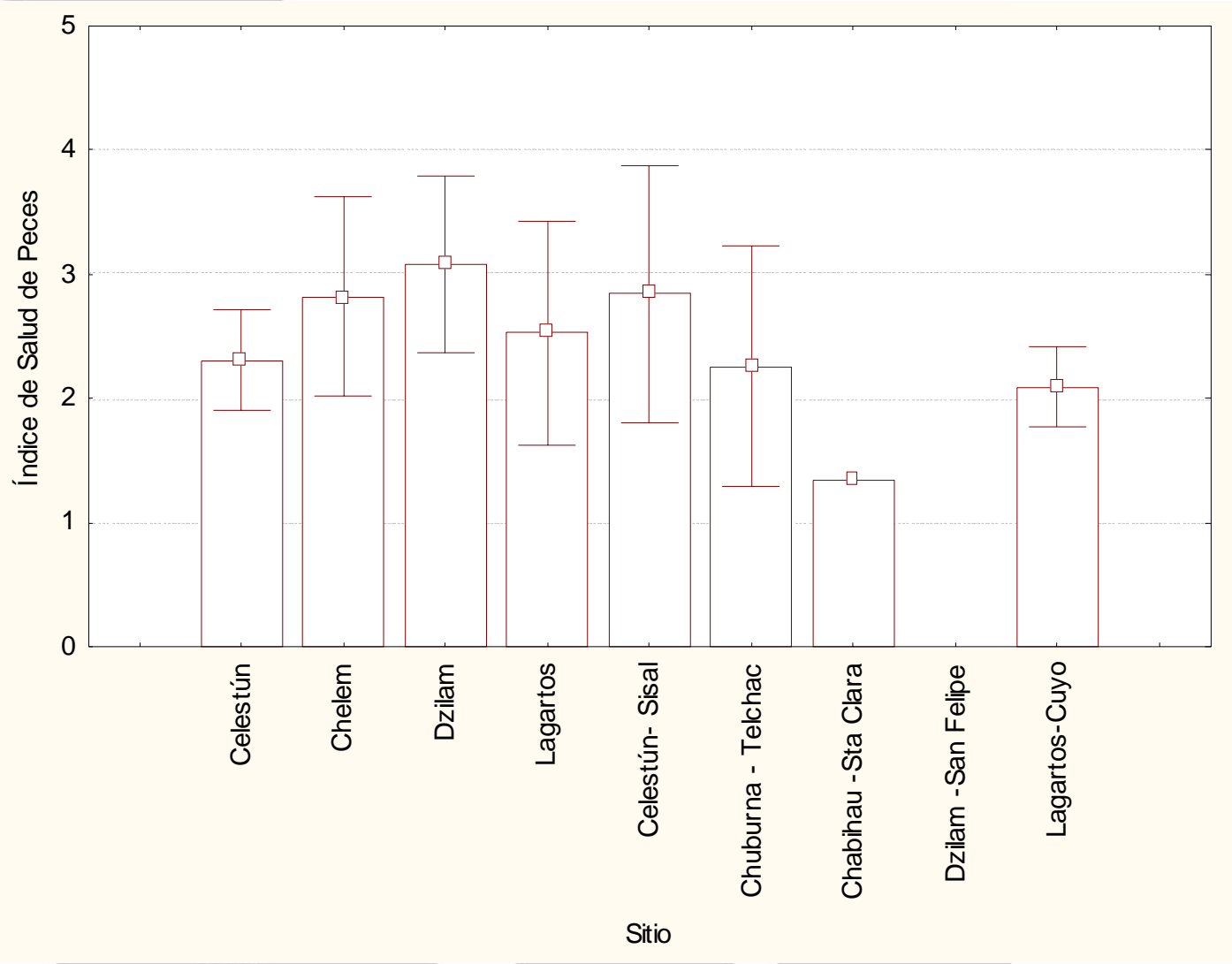
# Benthos



# Fish Health



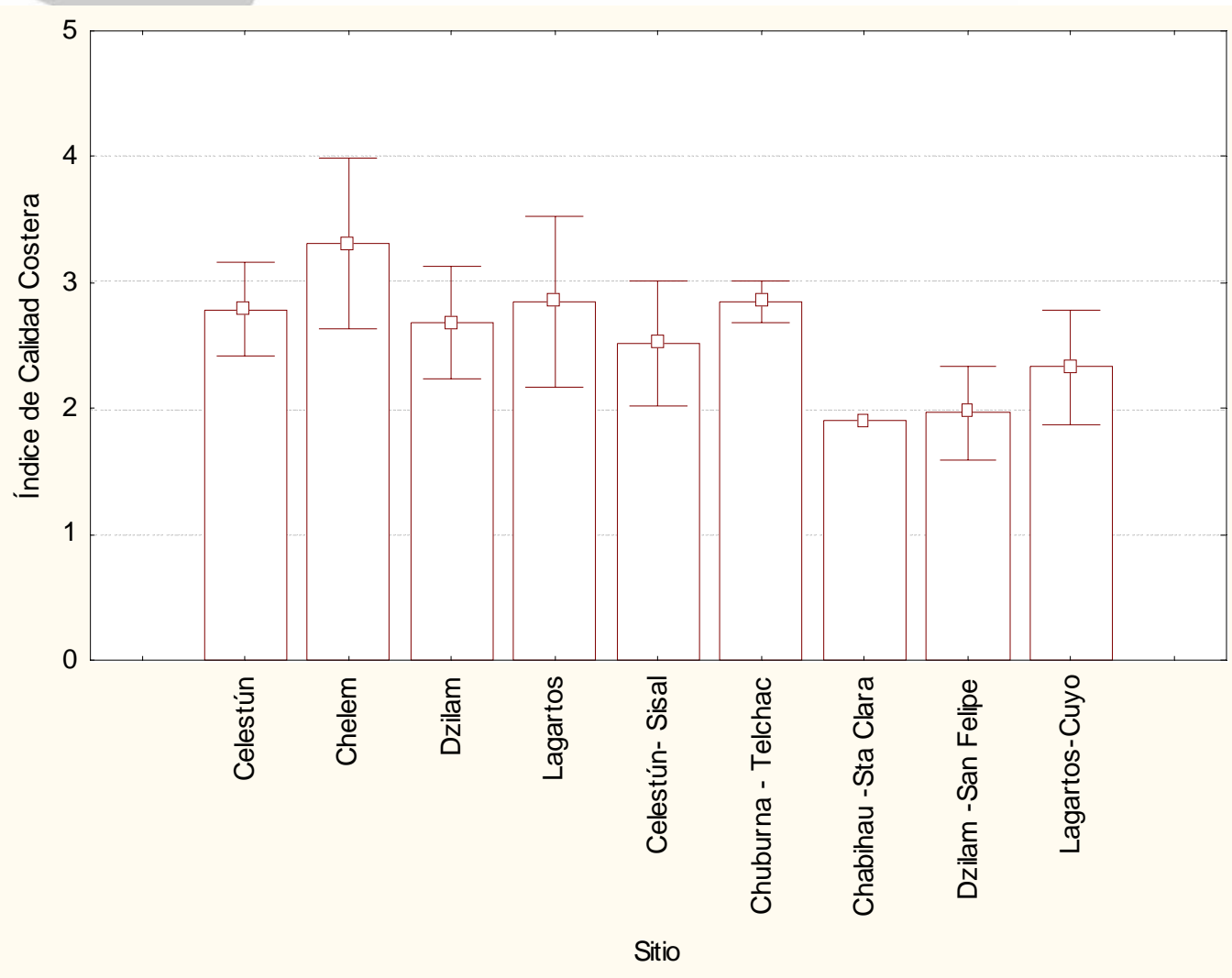
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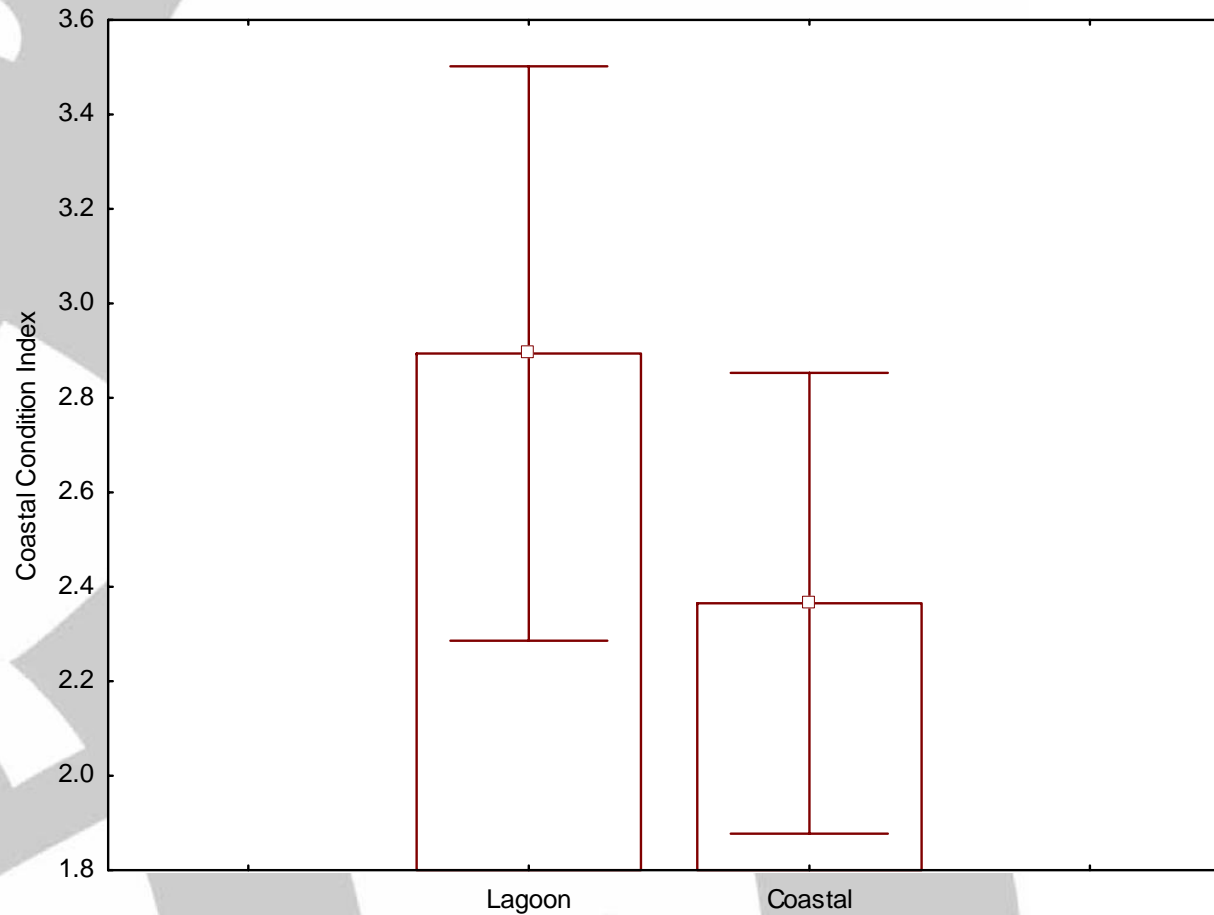
# Coastal Quality Index



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# Coastal Lagoons vs Coastal sites



Coastal sites are in better condition

# Coastal Quality Index . . .



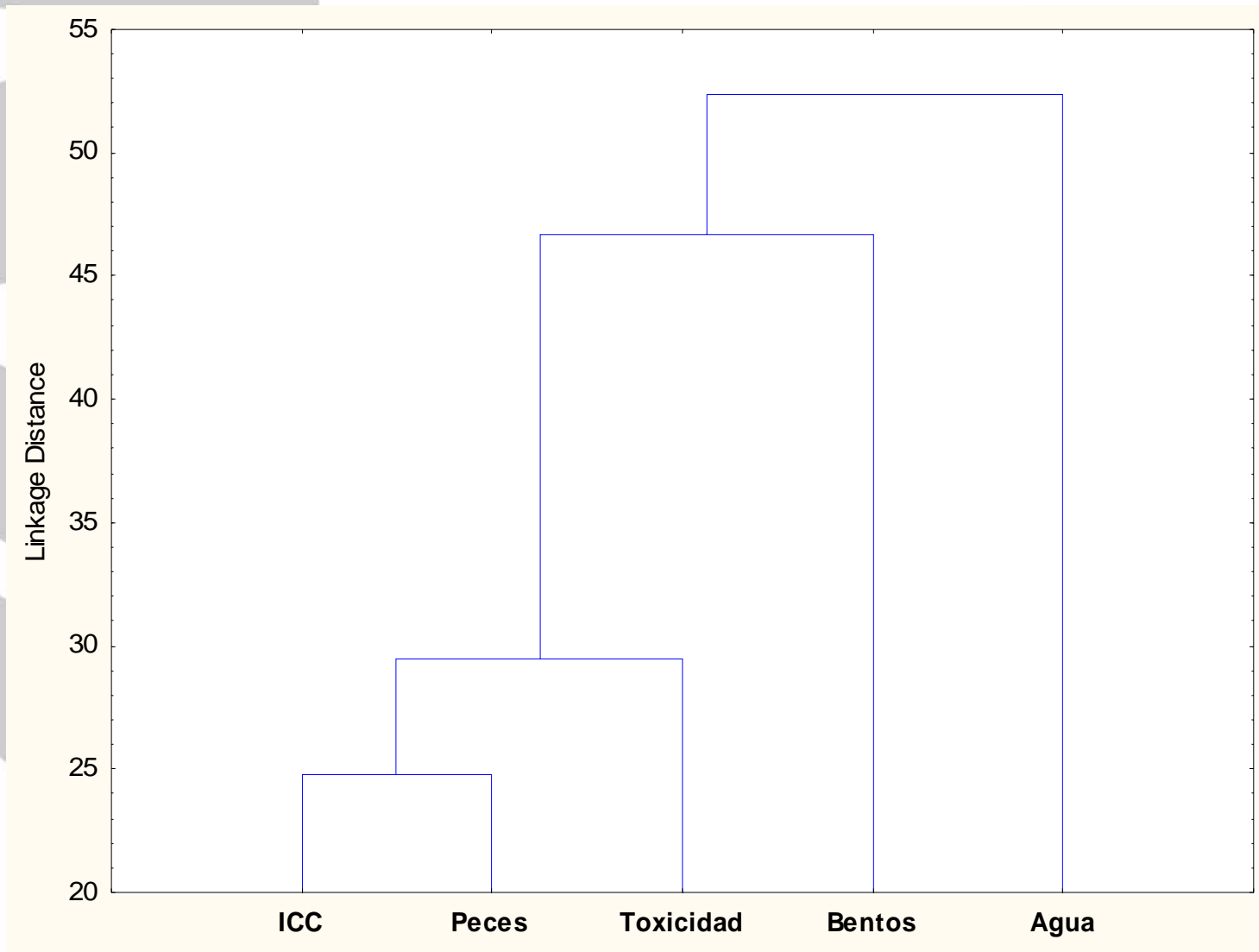
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- The average index for the coastal lagoons is:  
**2.9**
- The average for the USA Gulf of Mexico is:  
**2.4**
- Our coast is in about the same condition (if the two indices are comparable!)

# Similarity of the modules



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# Conclusions

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- Different indices usually fall in the “Regular” category
- Coastal lagoons are more impacted than the coastal zone
- Chelem is the most impacted lagoon, as well as the coastal zone from Chuburná to Telchac

# Things to do

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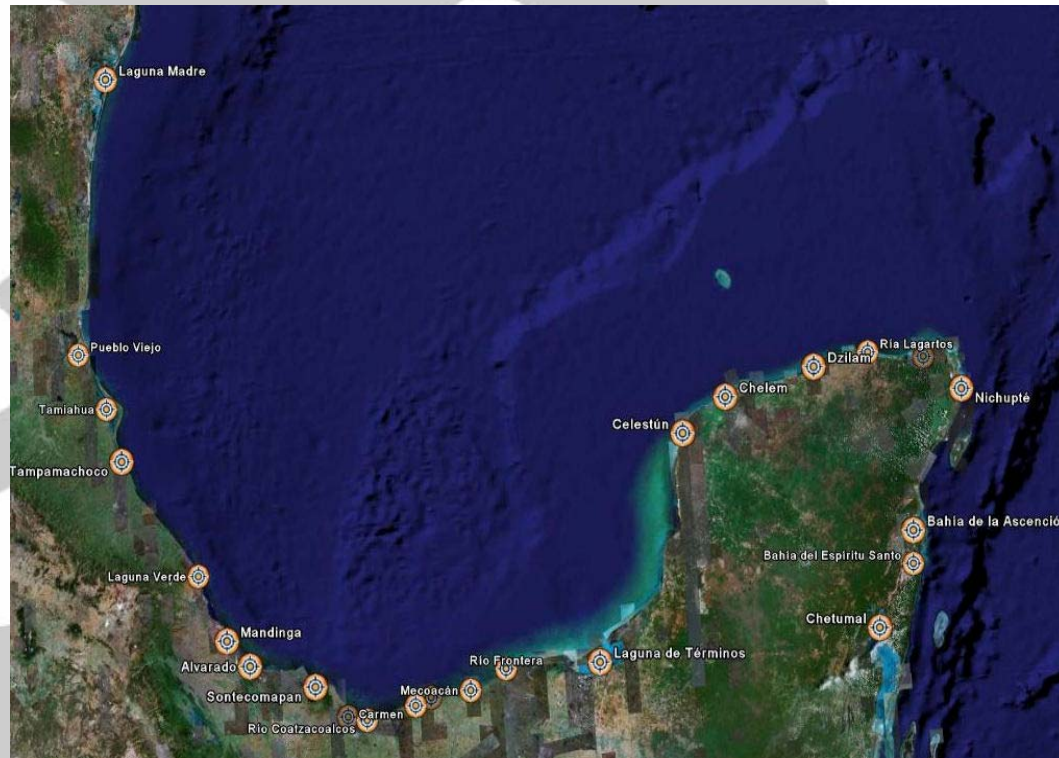
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- Include:
  - More biomarkers
    - AchE, Vg, LPO, etc.
  - Metals
  - Fish parasites
  - Fish community structure
- Improve the biomarker index
- Direct measurements of sediment toxicity
- “Calibrate” the benthic index
- Update information habitat alteration index
- Etc.



# Things to do . . .

- The process to develop the Ecological Land Use Plan for the Mexican Gulf of Mexico and Caribbean Sea just started
  - It is proposed to use the Yucatan program as a model for the monitoring program



# Things to do . . .



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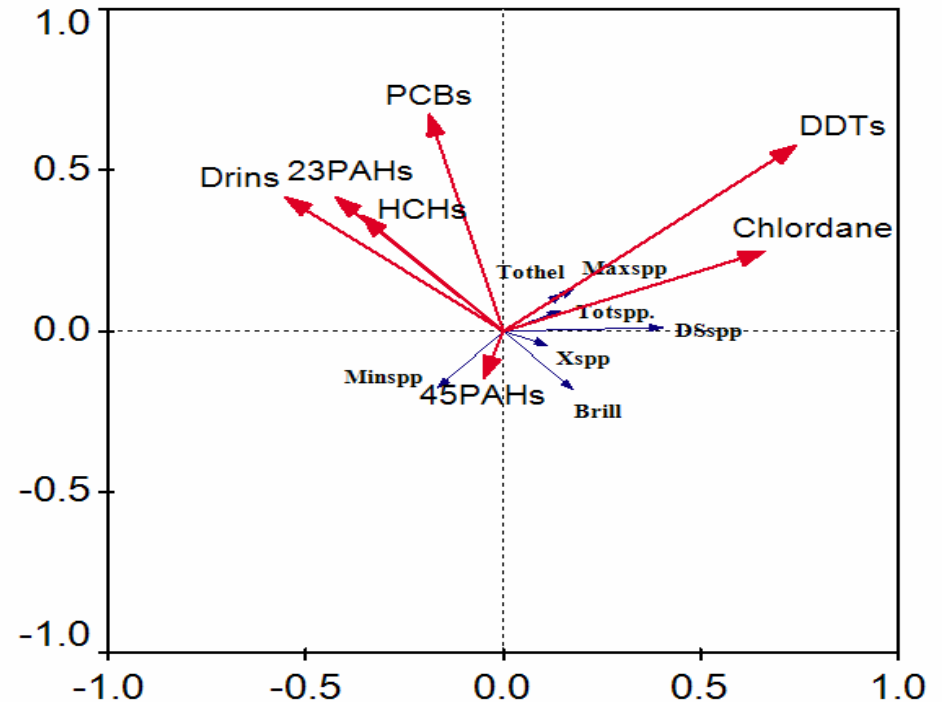
- Two Mexican regional workshops
  - Experts
  - Stakeholders
- International workshop(s)
  - Agree on a harmonized monitoring program for the Gulf of Mexico
    - Common
      - Indicators
      - Sampling procedures
      - Sample analysis
      - Etc.

# Things to do (Parasites)



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- 220 puffer fish
- Significant negative associations between pollutants and the number of individual helminths
- First axis: 39.8% of variance explained
- $F = 17.158$ ,  $p = 0.0002$



Brill = Brillouin diversity index, DSpp = species SD, Maxspp = maximum number of species, Minspp = minimum number of species, Totspp = total number of species, Xspp = mean number of species, Tothel = total number of helminths



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# Thanks !

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