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

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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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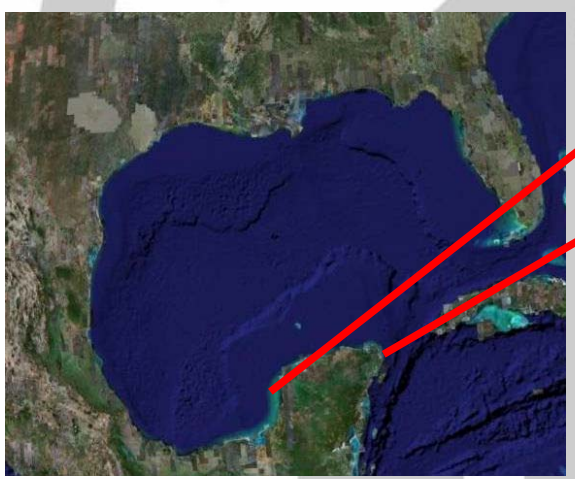
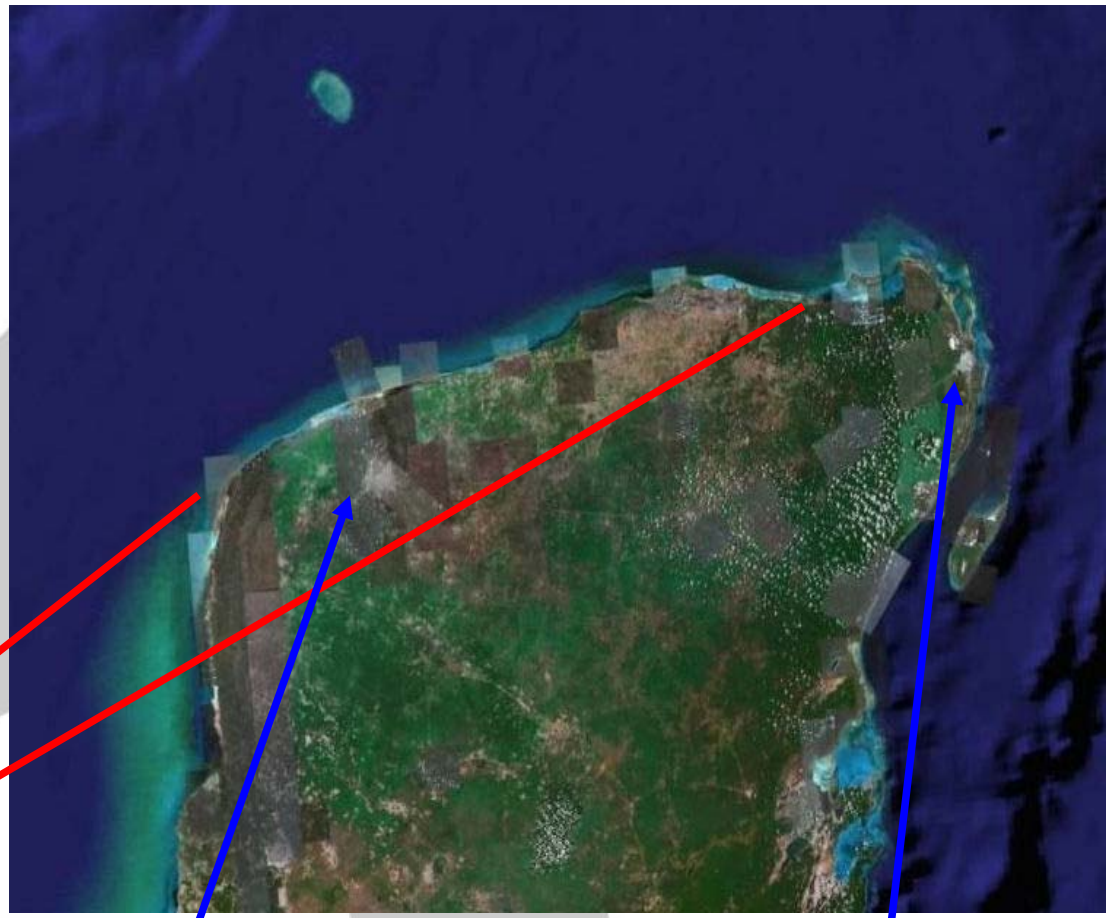
Coast of Yucatan
~ 350 km
No rivers or lakes
Only groundwater flow
12 – 16 x 10^6 m^3/km/y





Study Zone . . .

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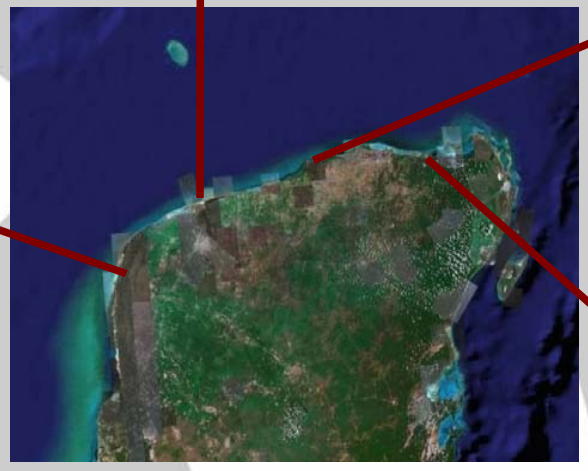
Chelem

Dzilam



Rio Lagartos

Celestun

Sampling Design

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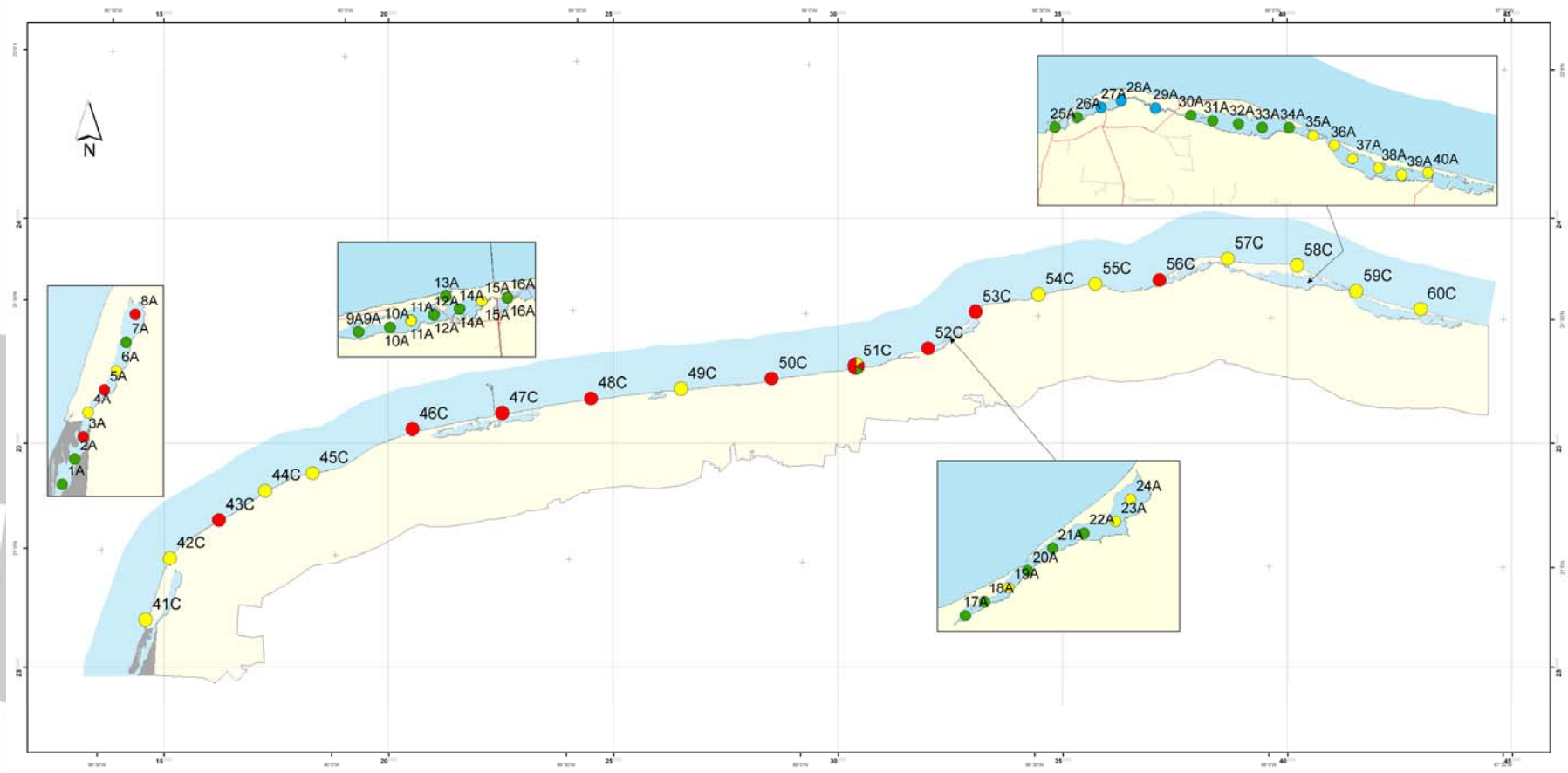

Samples were collected in 100 stations

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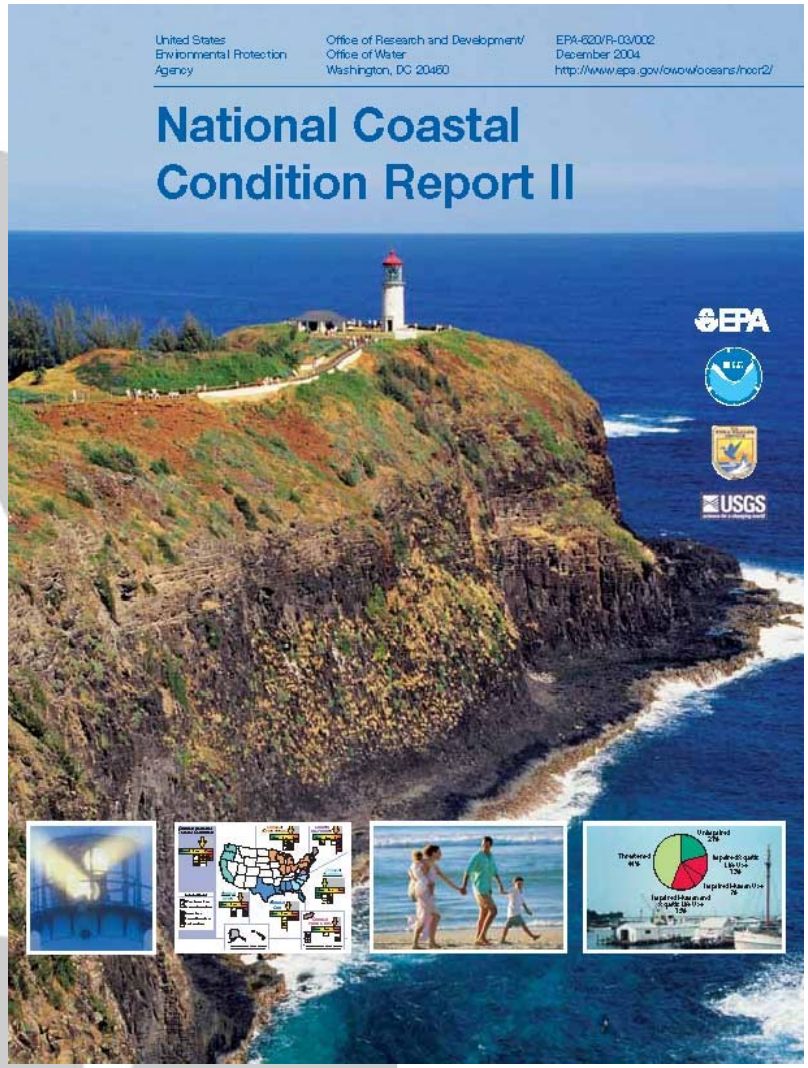
- For data analysis
- Similar to the National Coastal Condition
  - With some modifications



Water Quality

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- Considers water concentrations of:
  - Nitrates, nitrites, ammonium, phosphates, silicates, clorofils, dissolved oxigen, 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)
  - Syliidae (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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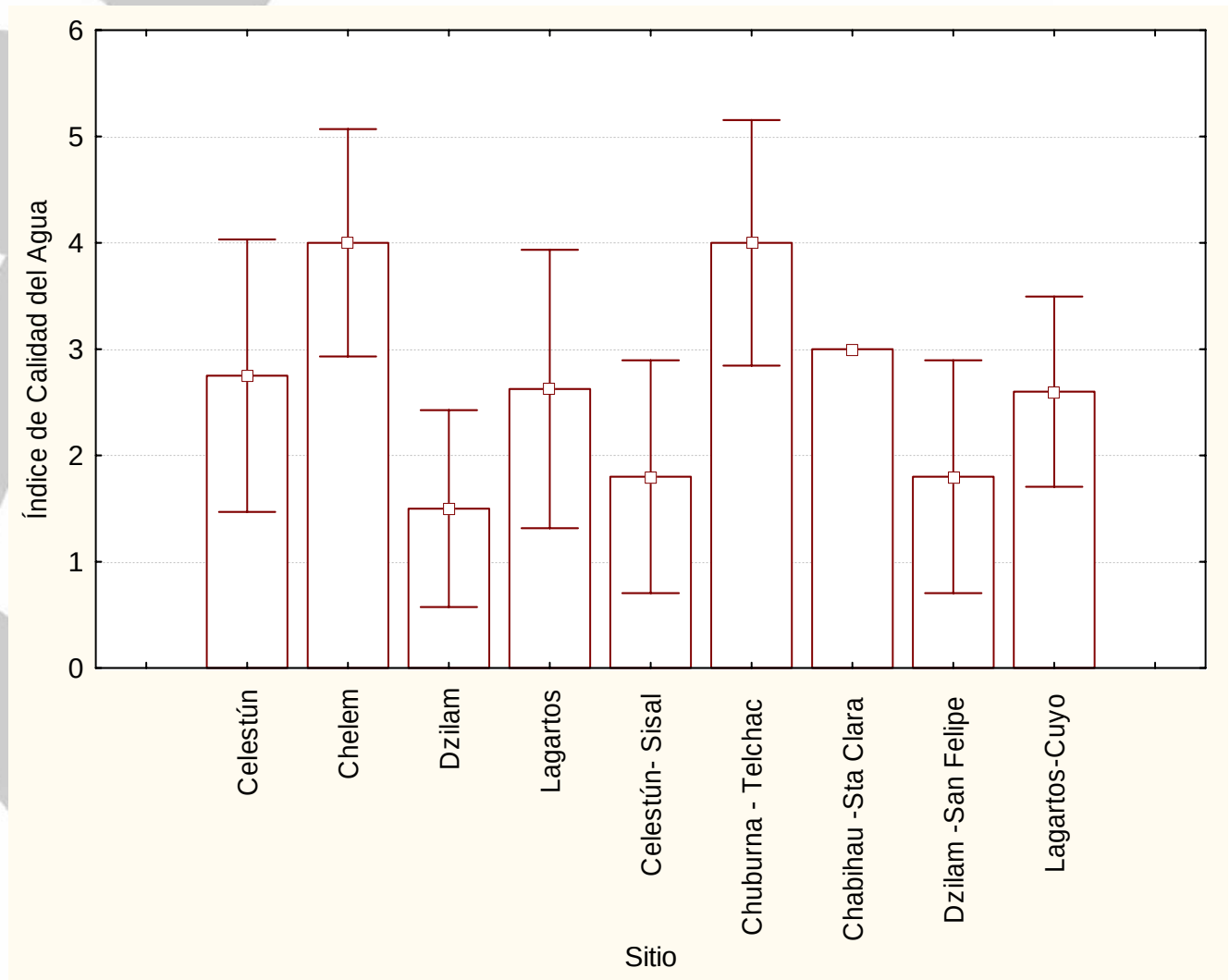

Sediment Quality

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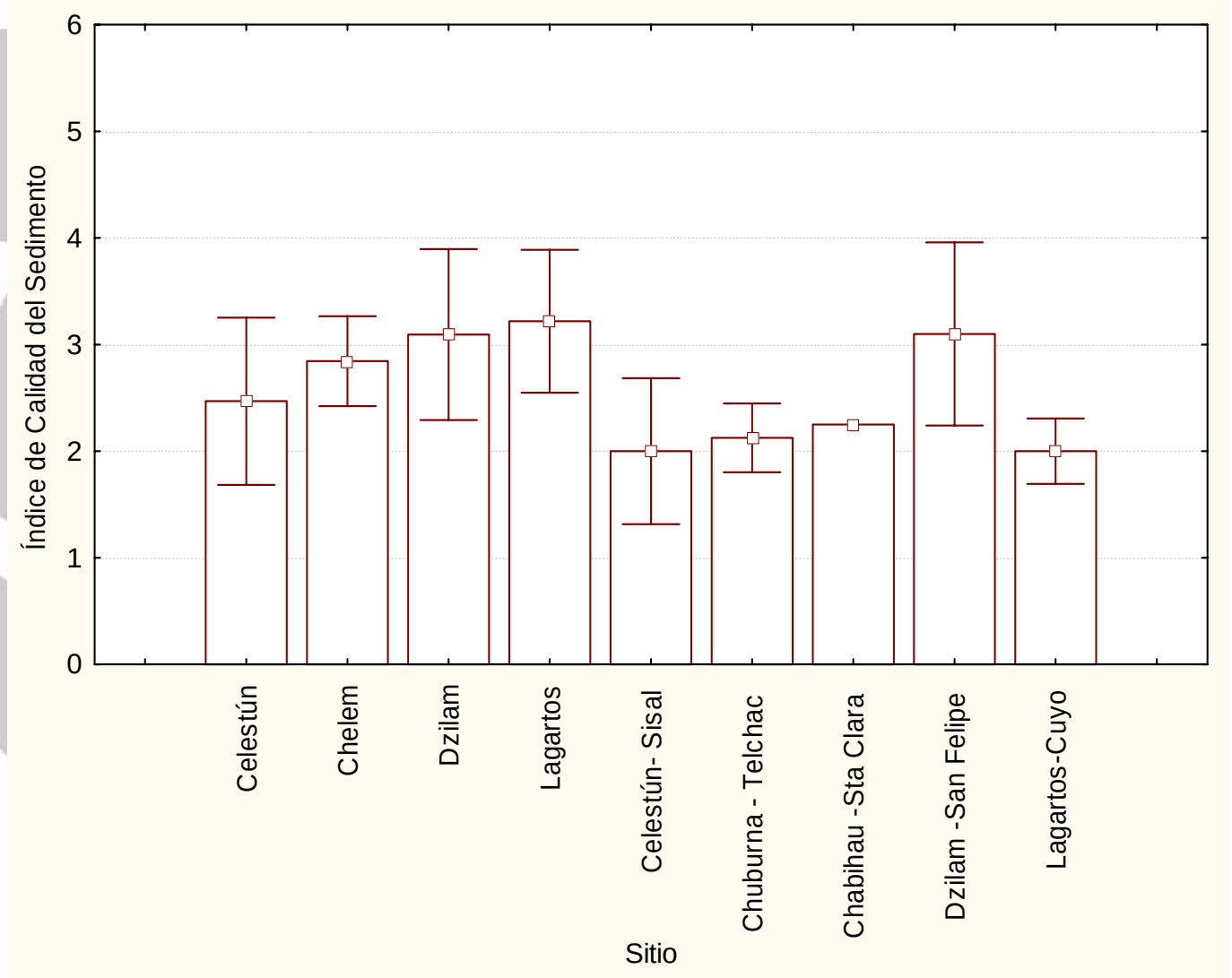

Benthos

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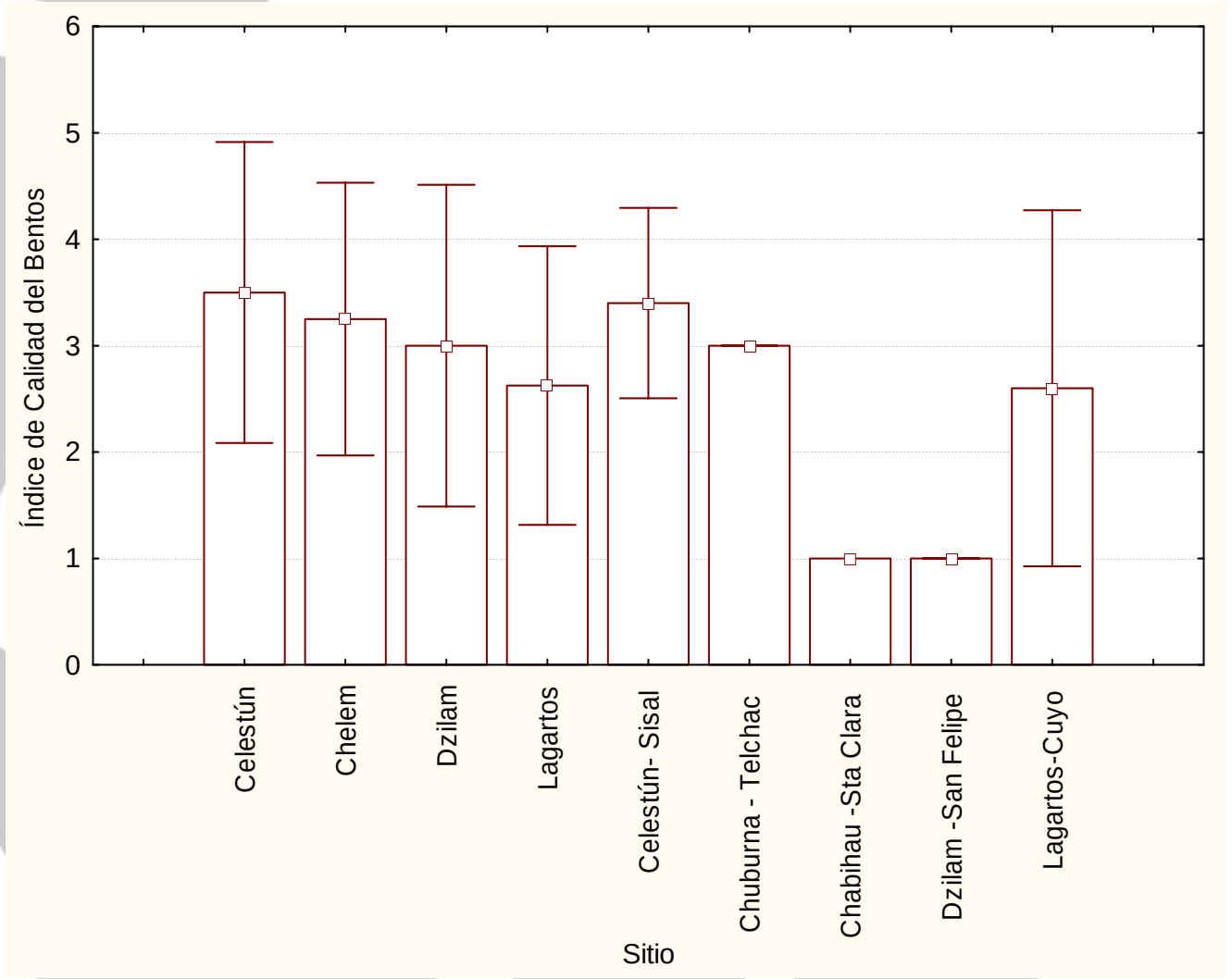

Fish Health

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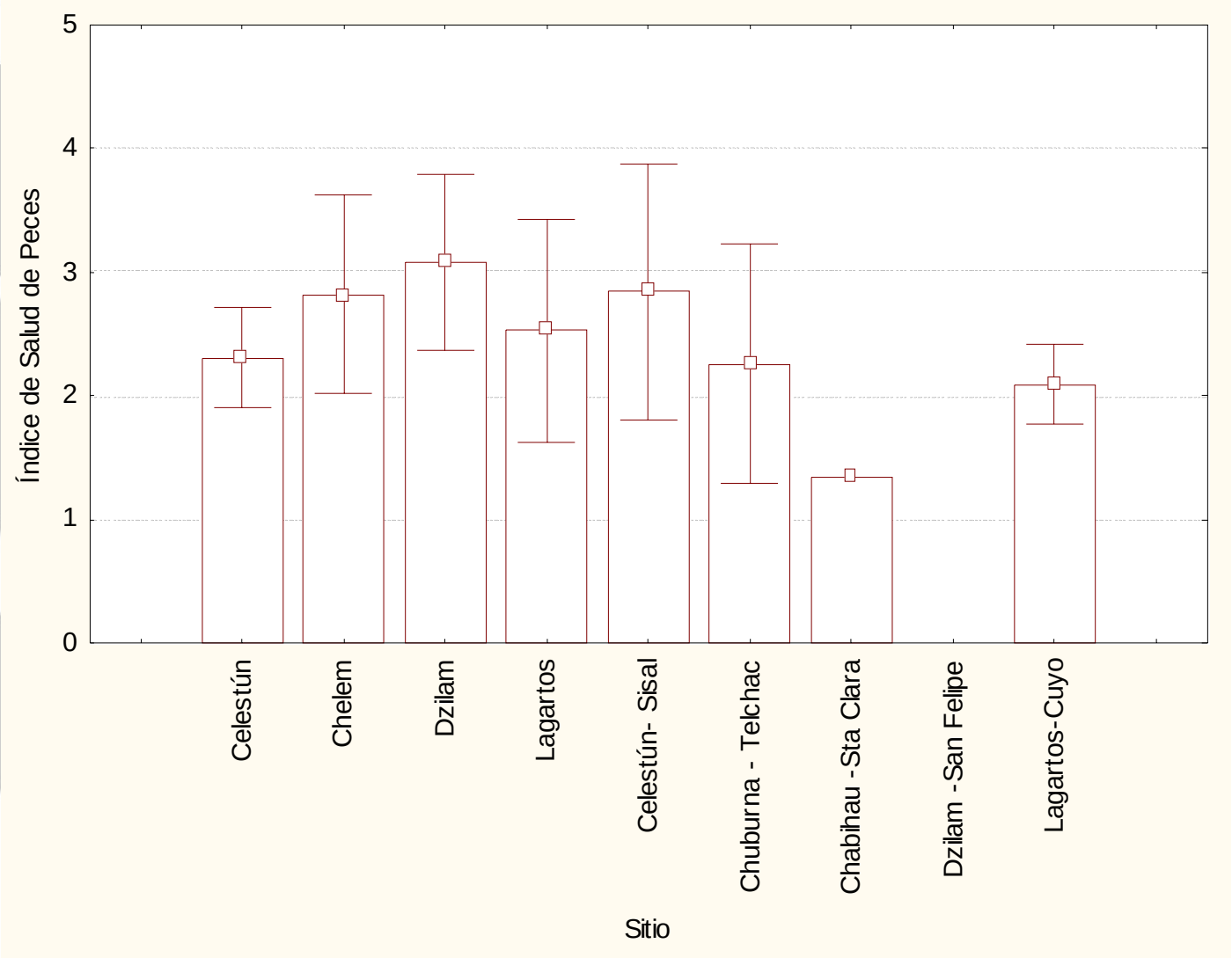

Coastal Quality Index

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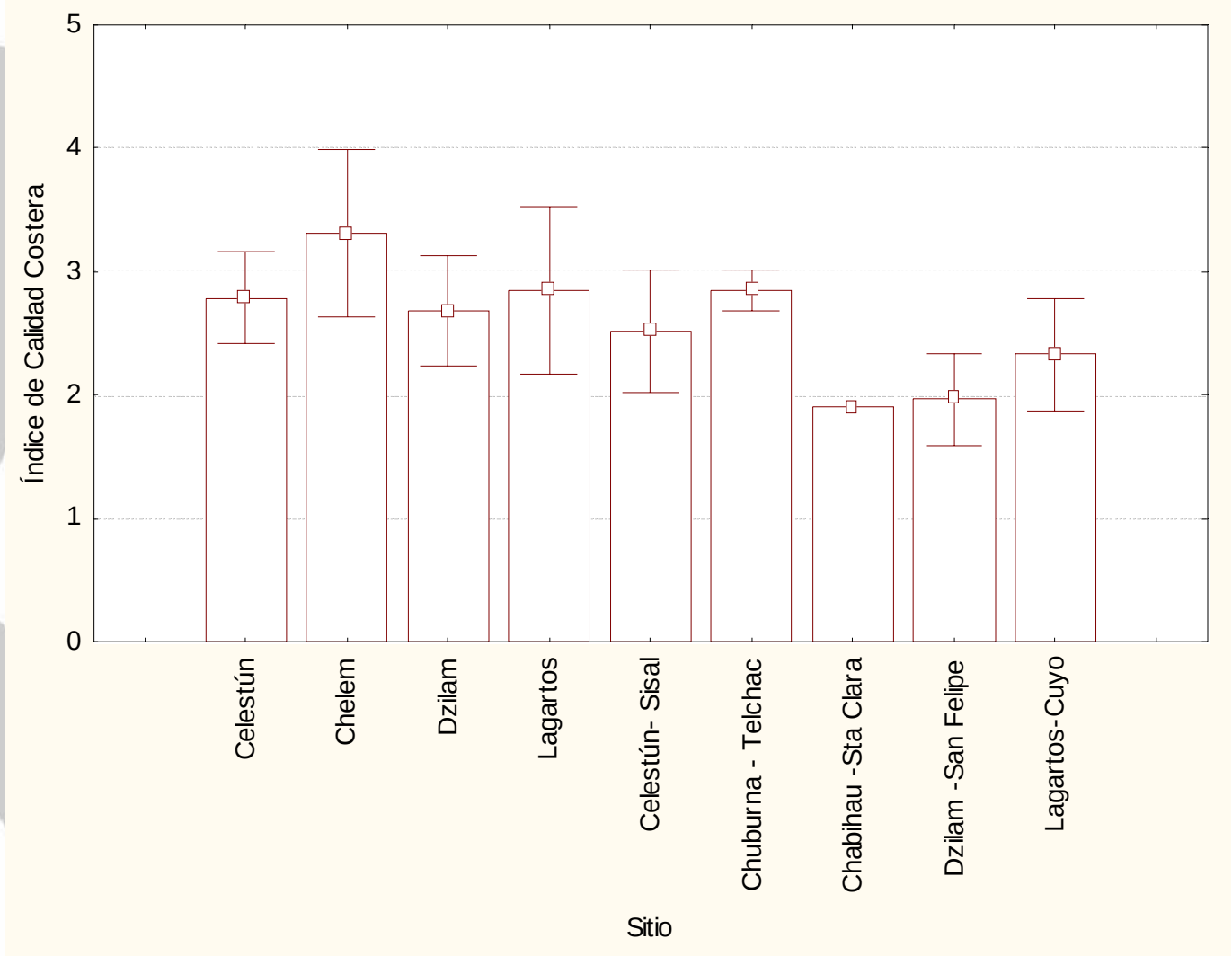

Coastal Lagoons vs Coastal sites

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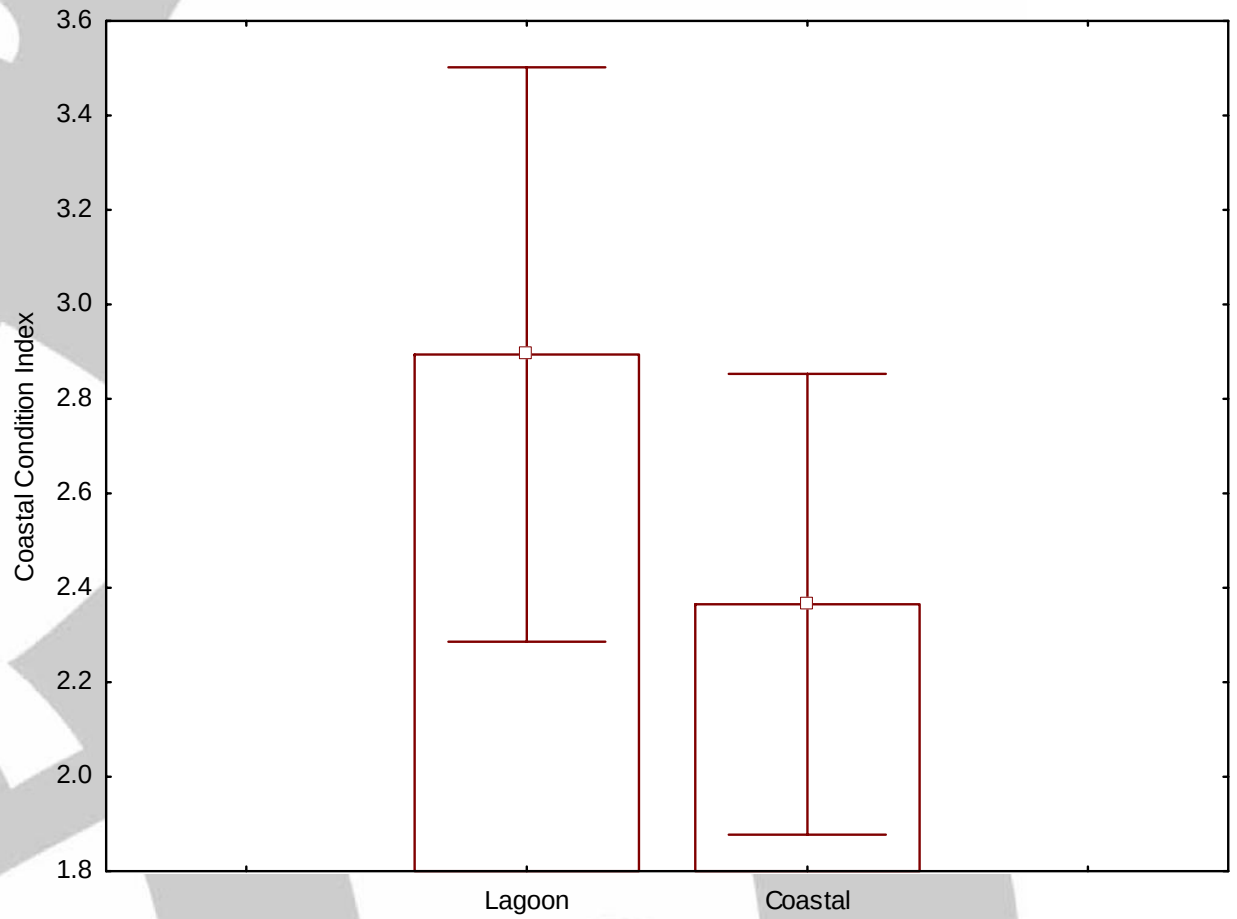

Coastal sites are in better condition

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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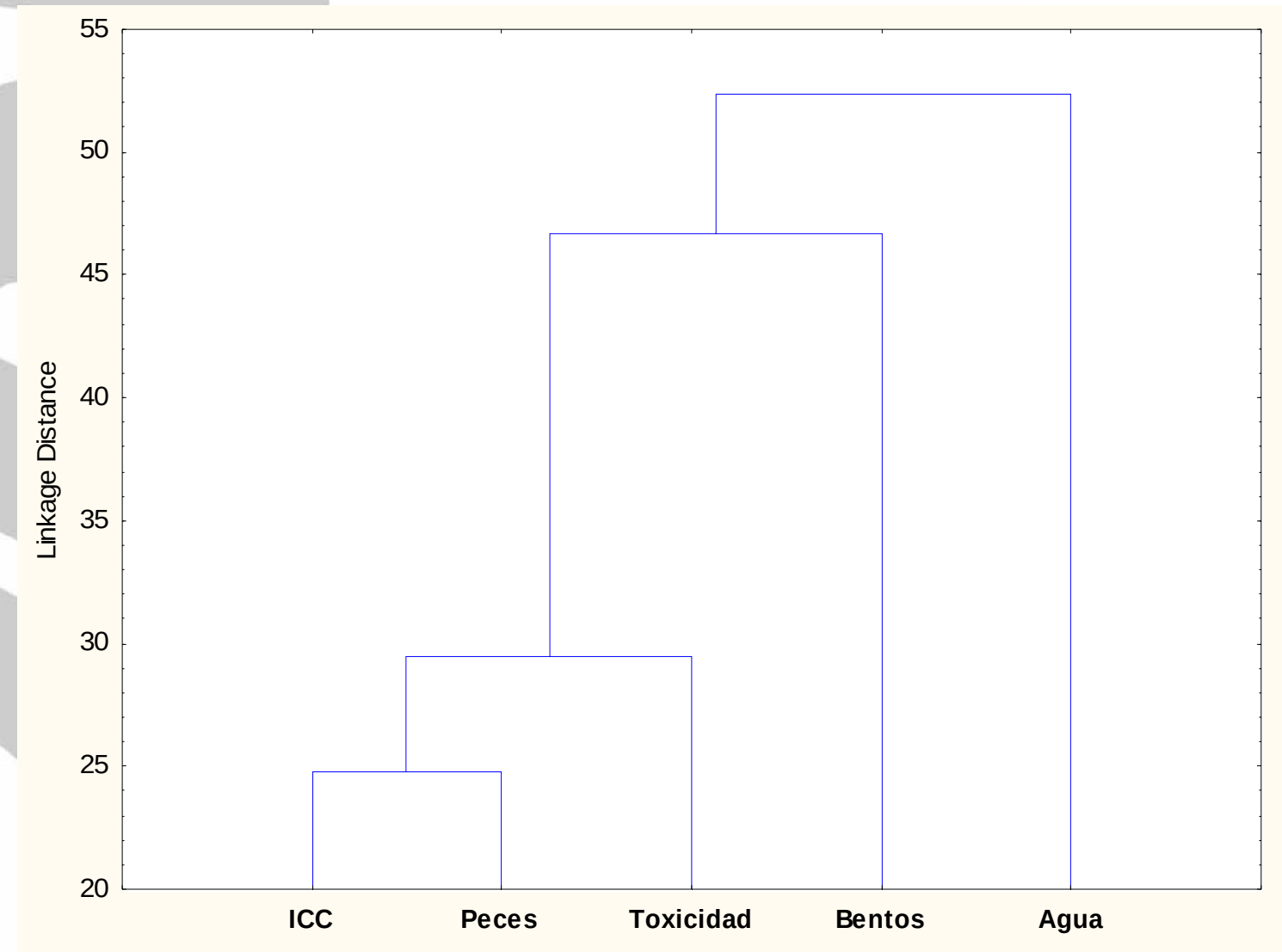

Conclusions

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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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- 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 . . .

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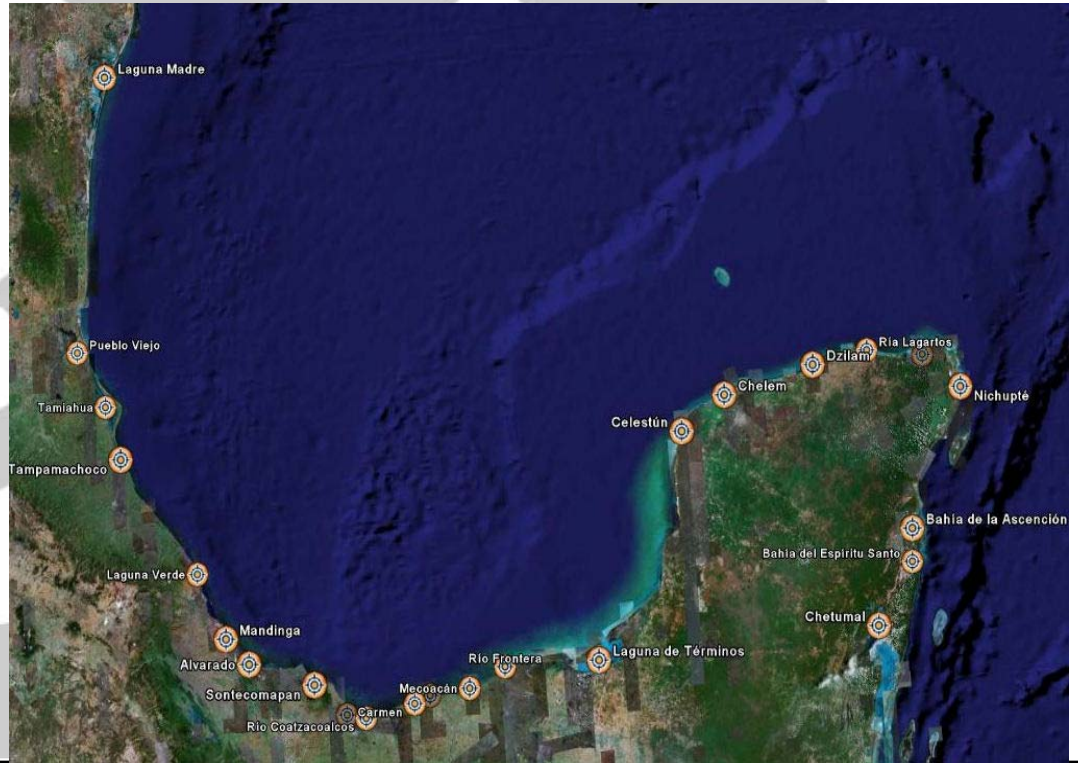
- The process to develop the Ecological Land Use Plan for the Mexican Gulf of Mexico and Caribbean Sea just started
  - It is proposed to use the Yucatan program as a model for the monitoring program



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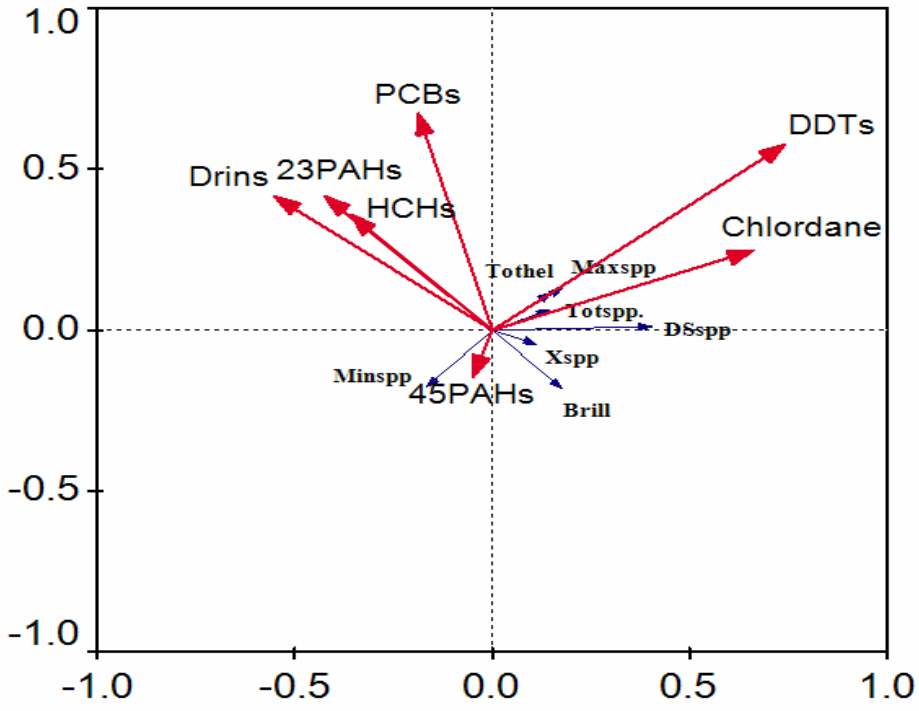
- 220 puffer fish
- Significant negative associations between pollutants and the number of individual helminths
- First axis: 39.8% of variance explained
- F = 17.158, p = 0.0002



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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