Water quality in aguadas within a protected karstic rain forest: the role of the vegetation-soil-water interactions

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INTRODUCTION

UNESCO, 2012:
Water ecosystems sustain the availability of water, that is, they cover the demand for water to maintain or restore the benefits that humans receive from the ecosystems themselves (services)

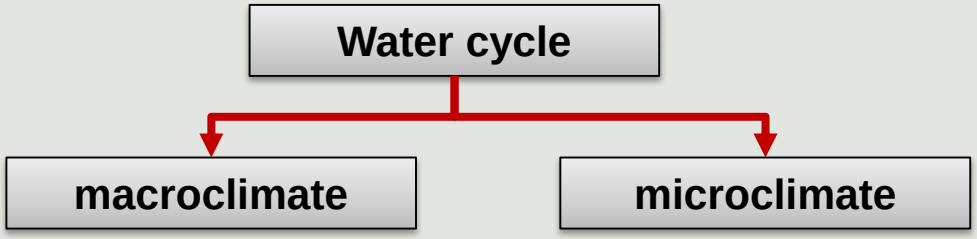
Land services:
Food production, climate regulation, fertility and soil characteristics, carbon storage and nutrient recirculation, damping of extraordinary events such as droughts and floods, among others

Values related to water services outweigh the most visible benefits
(Eg wood vs. carbon storage)

A healthy ecosystem demands to establish the natural conditions of the system in terms of quantity and quality

INTRODUCTION

Knowing the natural conditions (soil, air, water) make possible to identify



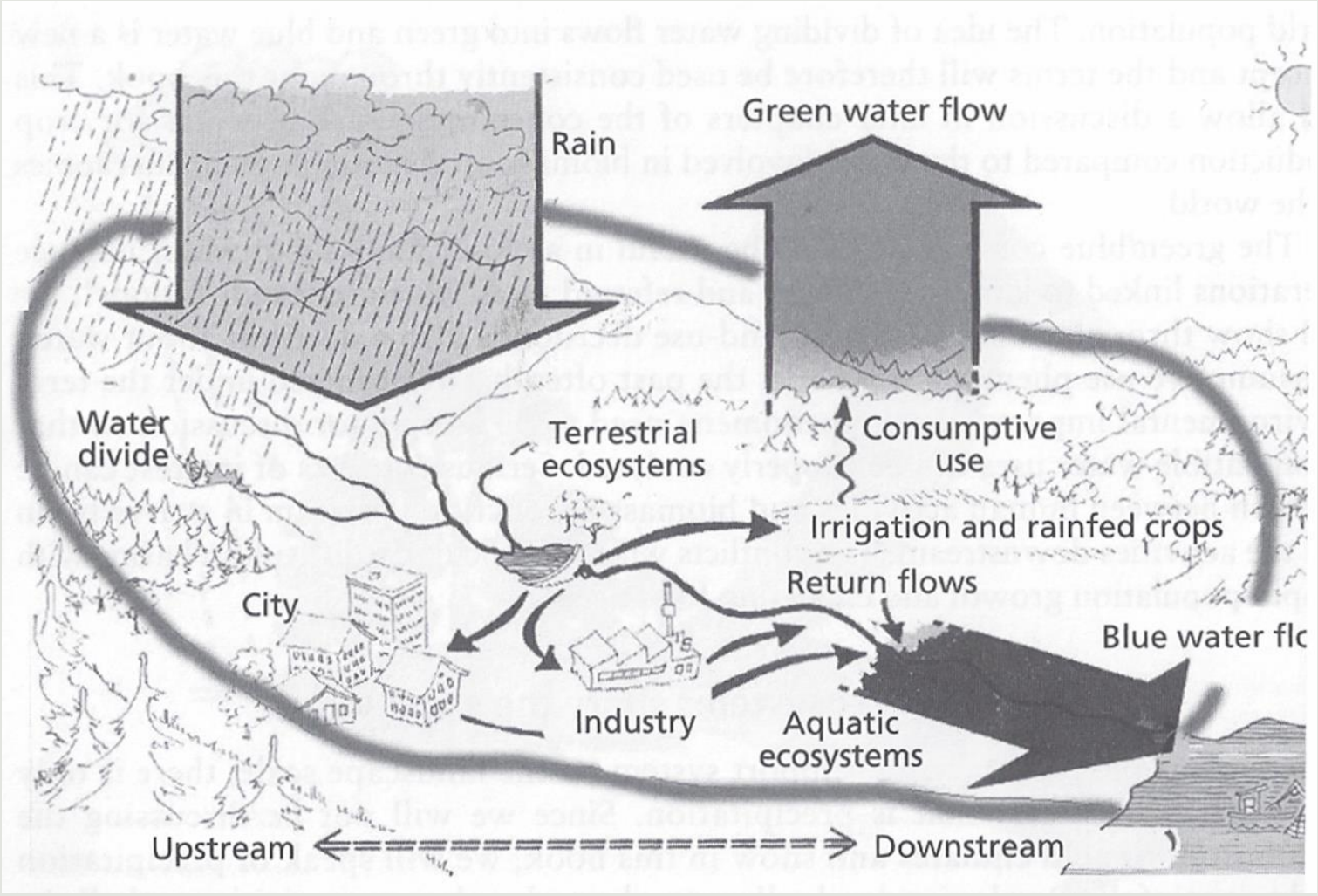
¿water quality?

- whether an ecosystem can withstand significant changes in its composition without affecting its functions, or
- whether an ecosystem is very sensitive to small changes in its physicochemical constituents leading to degradation of the ecosystem and loss of biodiversity.

The ability of aquatic systems to keep the ecosystem healthy depends of the availability of water and its physical, chemical and biological composition

Karst → $CaCO_3$

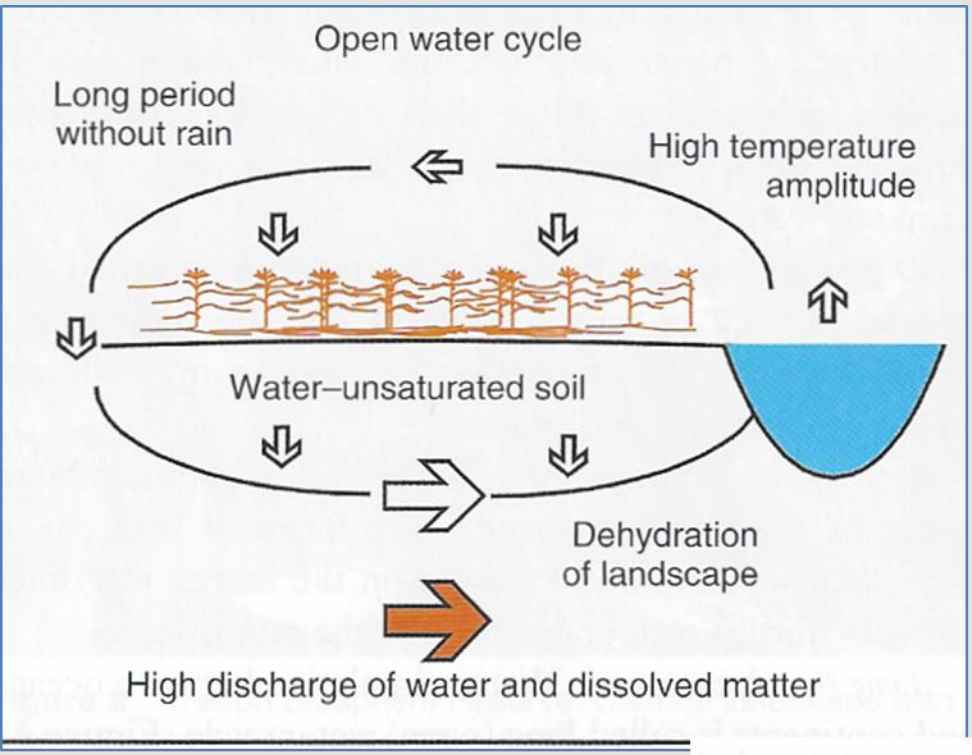
INTRODUCTION

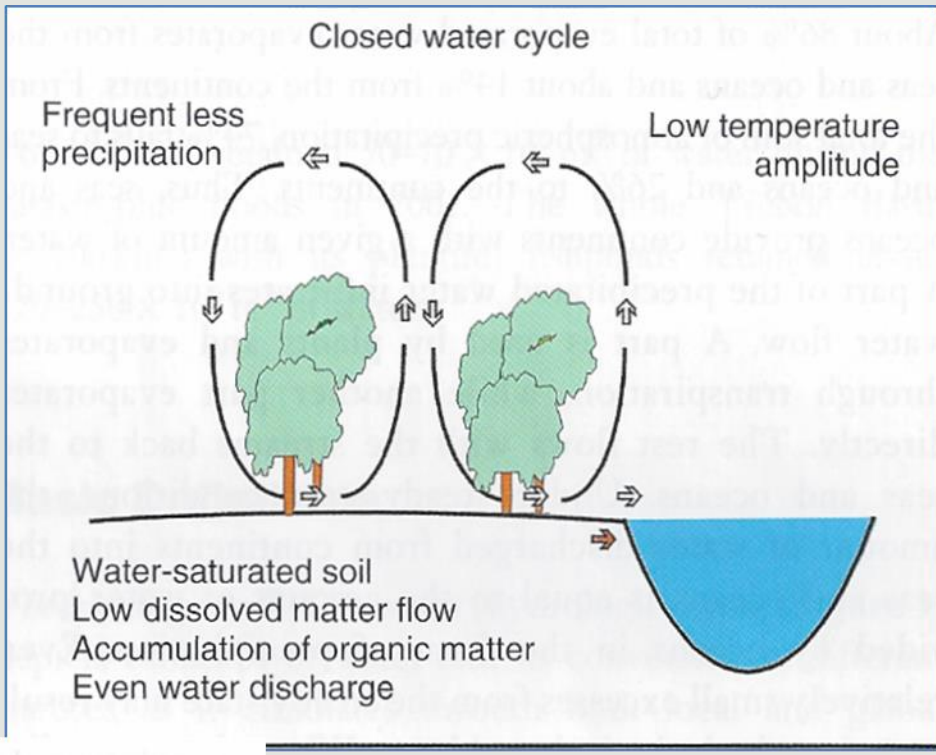


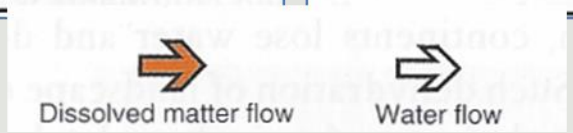
INTRODUCTION

Macroclimate

Microclima







Pokorny and Rejskova (2009)

AIMS

- to establish ***water quality in water bodies belonging to rural towns***, which have modified, in different degrees, the land use as response to their community necessities

- if *these* ***water bodies are polluted,*** to determine the pollution source: associated to human use of the natural resources (soil, vegetation and water) or it is a common response of the environment.

- to establish if ***these water bodies have the quality to continue with the actual net use, its resilience capacity***

STUDY AREA

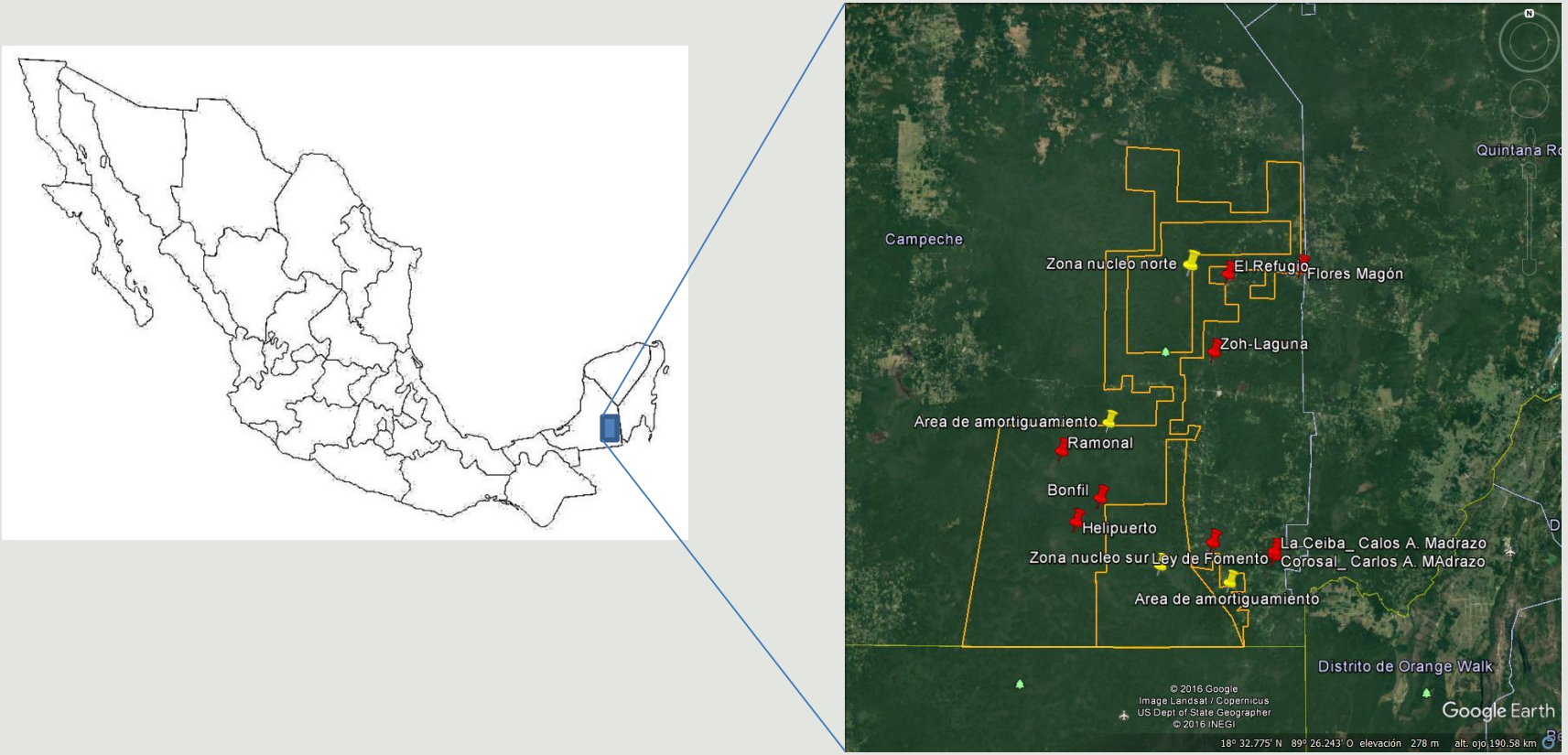


Figure 1. Nine Aguadas (red points) monitoring at the RBC (yellow line), Campeche, Mexico.

STUDY AREA

Climate: Warm sub-wet
Temperature: 26°C
Precipitation:1,250mm
Type of soils: Karst
Vegetation: Tropical Forest - Shrub
Main water bodies: Aguadas

Calcareous origin: they contain 15% of $CaCO_3$ in pulverulent, nodules, scabs, among others forms).

Due to the water percolation loaded with CO_2 on limestone, the soils are very porous and thin, so rainwater is rapidly filtered, with practically no surface drainage

SHORTAGE PROBLEMS:

- Climate and hydrogeology
- Complexity of the ecosystem, fresh water is scarce

STUDY ZONE:

Sities

El Refugio

Ley de Fomento

El Ramonal

Flores Magón

Corosal

Carlos A. Madrazo

Bonfil

Zoh-Laguna

Ceiba

Helipuerto

METHODOLOGY: NORMATIVITY

Constitution, Law of Waters, Mexican Official Norms that regulate the quality of the water by use, establishing limits by type of discharge and parameters to monitor.

- NOM-001-SEMARNAT-1996 establishes the maximum permissible limits of pollutants in the discharges of residual waters in national waters and goods.

- NOM-127-SSA1-1994, environmental health. Water for use and human consumption. It establishes the permissible limits of quality and treatments that must undergo the water for its purification. Includes your modification.

- NMX-AA-014-1980, which establishes the general guidelines and recommendations for sampling in bodies receiving surface water, excluding estuarine waters and marine waters, in order to determine their physical, chemical and bacteriological characteristics and the corresponding Test Method.

RESULTS

Microorganisms – Total Coliforms

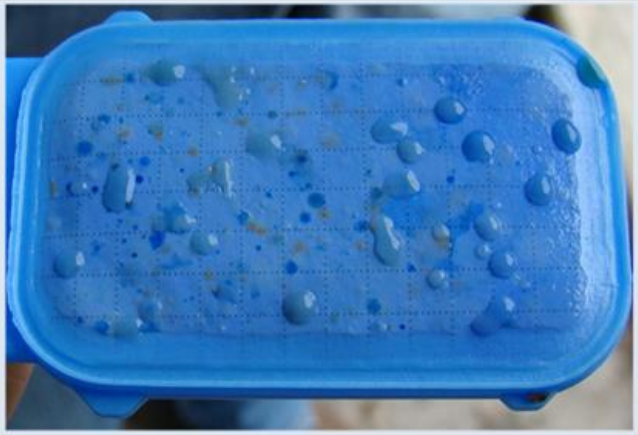
Date	Site and time	pH	No. colonies	Swab
03/05/2014	Carlos A. Madrazo La Ceiba 2:20 pm	8	50	

Date	Site and time	pH	No. colonies	Swab
03/05/2014	Carlos A. Madrazo Corosal 4:22 pm	8	muy numerosas para contar	

Figure 2. Aguadas La Ceiba (unaltered) and Corosal (altered) in Carlos A. Madrazo locality.

RESULTS

Microorganisms – Total Coliforms

Fecha	Sitio Hora	pH	Núm colonias	Imagen
02/05/2014	Flores Magón 2:00 pm	8	97	
02/05/2014	El Refugio 4:45 pm	8	50	

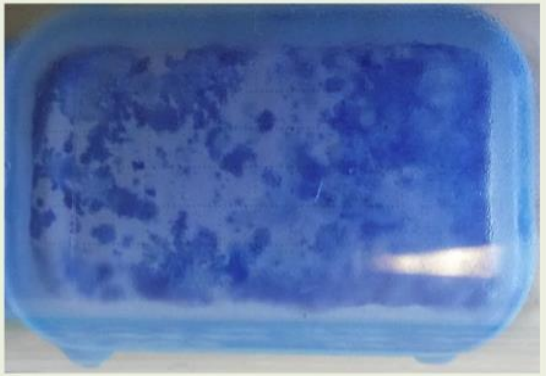
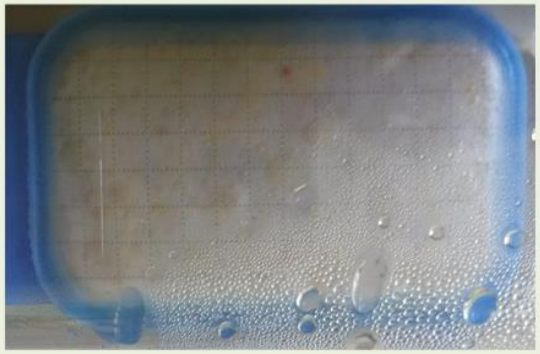
pH,
7-8 slightly alkaline (calcium carbonates)

7 in the Archeological zone (El Ramonal, Bonfil y el Helipuerto)

Coliformes
High values are assoated to:

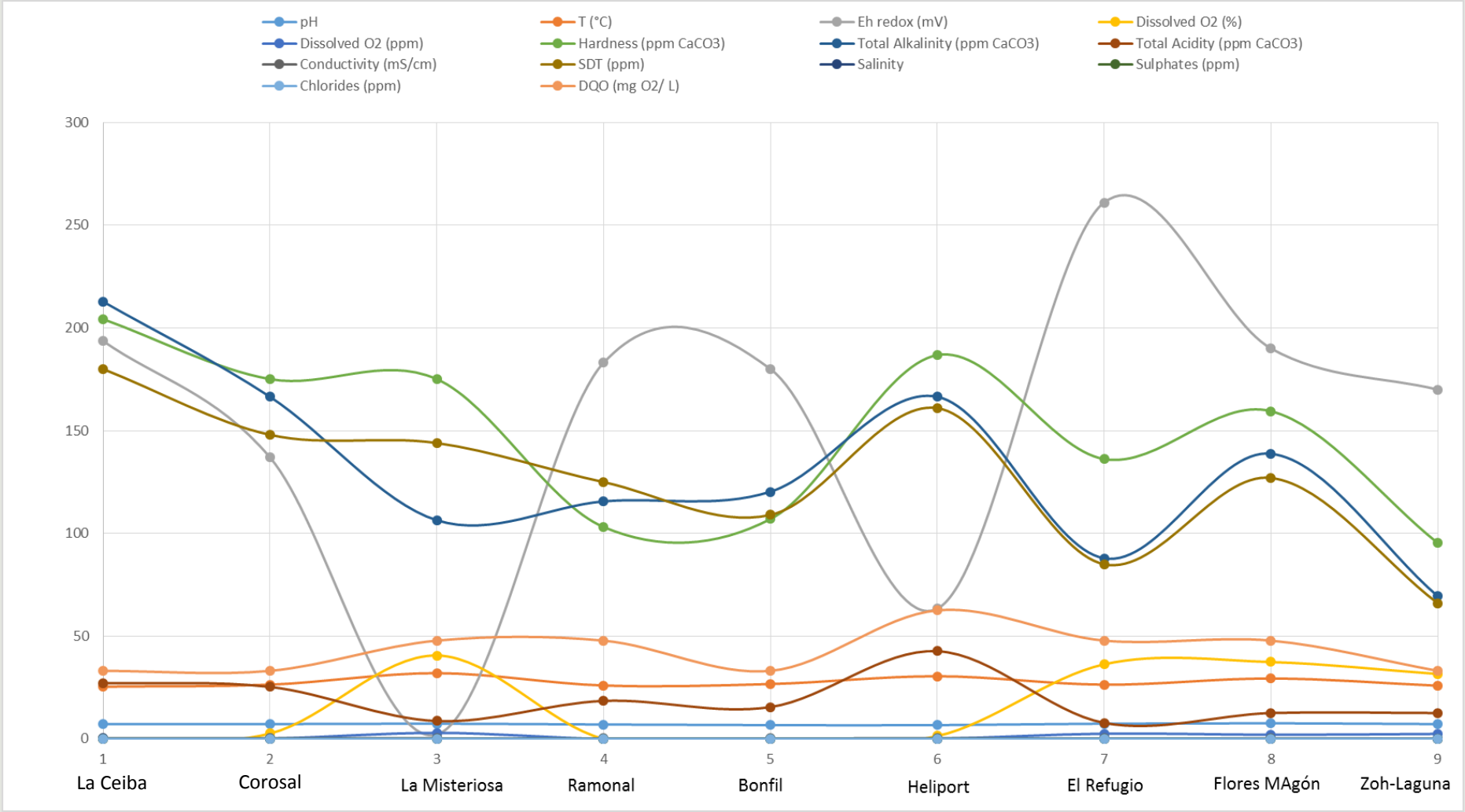
Rainy season due to the drag of pollutants, and
Those aguadas with human influence:
Corosal+++,

Or animal influence:
Archeological zone: fauna+++

Fecha	Sitio Hora	pH	Núm colonias	Imagen
04/05/2014	El Ramonal 11:41 am	7	muy numerosas para contar	
04/05/2014	Bonfil 1:35 pm	7	100	
04/05/2014	Helipuerto 3:05 pm	7	muy numerosas para contar	

RESULTS

Physico-chemical parameters



RESULTS

Metals parameters

Table 4. Metals observed in the nine aguadas obtained by the ICP (NMX-AA-131-SCFI-2005). Limits are expressed in mg/L, except where otherwise indicated

		South			Archeologycal			North		
Element	DL (mg/L)	La Ceiba	Corosal	La Misteriosa	Ramonal	Bonfil	Heliport	Refugio	Flores Magon	Zoh-Laguna
Al	0.004	**0.128**	0.063	0.048	0.023		0.018		0.012	
Ba	0.002	0.144	0.154	**0.228**	0.05	0.143	0.146	0.026	0.05	0.016
Ca	0.01	107.353	58.413	115.455	393.202	406.353	356.179	**413.486**	410.473	352.823
Cd	0.001	0.026	0.05	0.023	0.043	**0.065**	0.045	0.015		0.023
Cu	0.005	**0.046**	0.027	0.019	0.022	0.01	0.015	0.007	0.008	0.009
Fe	0.001	**0.242**	0.079	0.021	0.076	0.051	0.033			0.022
K	0.01	8.082	10.856	2.157	8.421	11.597	**14.304**	6.39	5.292	4.124
Mg	0.01	**6.104**	5.543	4.367	2.094	3.956	4.836	2.253	2.469	1.805
Mn	0.001	0.087	0.079	**0.115**	0.093	0.078	0.048	0.035	0.005	0.013
Na	0.01	4.106	4.55	**16.648**	**22.381**	8.367	12.669	4.903	5.083	11.967
Sr	0.014	0.074	0.042	**0.207**	**0.228**	0.245	0.4	0.077	0.234	0.174
As	0.005	**0.019**								
V	0.001	**0.041**								

- **Ca, Na, K and Mg** = natural influence by rock washing or erosion in the subsurface and surface (presence of carbonates of sodium, calcium, magnesium and potassium by the clay-limestone soil) Schmitter-Soto et al. (2002).
- **Cd, Mn, Cu, Fe, Al, Ba and Sr**. i.e. Sr is related to natural soil sources at the Yucatan Peninsula
- **La Ceiba** some traces of
  arsenic 0.019 mg/L<0.005 mg/L from the NOM and
  vanadium 0.041 mg/L>0.001 mg/L form NOM were detected

CONCLUSIONES

- The physicochemical characteristics are similar by zone / the northern and the archaeological zones present more similarities due to the presence clay soil
- The influence of the vegetation is important as it can favor the arrival of micronutrients by drag sediments from soil that in its superficial part has organic matter, which maintains the biodiversity.
- Human being contributes with domestic animals, nutrients to the system, diminishing dissolved oxygen and in the long term generating eutrophication.
    - However, all metals are mainly associated to natural conditions at the Yucatan Peninsula
- The aguadas that are not impacted by animals can be used for direct use, although it is recommended not for drink because of high calcium levels

Water is clean, with a sandy bottom and a homogenous, oxygenated water mass (aquatic plants). There are no horizontal differences (physical or chemical) related to its small surface areas, which favors water flow due to low retention times

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Gracias

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