



## GROUNDWATER QUALITY IN A KARSTIC ZONE OF THE ISLAND OF COZUMEL, QUINTANA ROO, MEXICO †

[CALIDAD DEL AGUA SUBTERRÁNEA EN UNA ZONA KÁRSTICA DE LA ISLA DE COZUMEL, QUINTANA ROO, MÉXICO]

Alex Fernando Contreras-Tax\*, Oscar Frausto-Martínez  
and **Wilbert David Uhu-Yam**

*Laboratorio de observación e investigación espacial, Universidad de Quintana Roo.  
Avenida Andrés Quintana Roo s/n, esq. Calle 110 sur. Col. Maravilla, C.P. 77600,  
Cozumel, Quintana Roo, México. Email. alexfe.contreras@hotmail.com\*,  
ofrausto@uqroo.edu.mx, 1416861@uqroo.mx  
\*Corresponding author*

### SUMMARY

**Background.** In the Yucatan peninsula, the main source of water supply for all human activities is groundwater; however, it is highly vulnerable to pollution due to the characteristics of the karst aquifer, which allow a direct and a very susceptible infiltration to pollutant transport. The same process occurs in the islands systems of the east side of the peninsula, particularly on the islands of Holbox, Isla Mujeres and Cozumel, the latter being the most populated (almost 100 000 inhabitants) and with the existence of irregular settlements in the protection areas and water abstraction. **Objective.** In order to understand the characteristics of the groundwater quality, the aim of this study is to sample, determine and map the spatial and temporal behavior of water as a resource, as well as to determine if there are significant differences among the sampling seasons. **Methodology.** To be able to do so, the sampling sites were determined under the following premises: the number of people residing in the plot of land, the years that people have resided in the settlement, if they own an extraction well for domestic use, if they possess a water extraction pump, if they have no drainage, if they burn their garbage and if they have ever become ill from using the extracted water for bathing. Regarding the physical and chemical parameters (temperature, pH, salinity and TDS) they were analyzed *in situ* with multi-parametric instruments; while the bacteriological study was measured by means of the Millipore ® membrane filtration method and chloride were completed in the laboratory; the samplings correspond to three periods (rainy, “Nortes” and dry seasons). The shaping of the spatial pattern of distribution for each parameter was developed using IDW interpolation. Finally, the statistical analysis was conducted with the one-way ANOVA statistical test, as well as the post hoc test for those parameters that had significant differences. **Results.** Thus, eight sampling sites were selected taking into consideration the representative distribution of the territory (132 wells were recognized). In addition, the results tables of the parameters for the rainy, “Nortes” and dry seasons are presented in this document, as well as the maps of spatial distribution. **Implications.** The main limitation to carry out this research was the prohibition when taking two samples, since, for different circumstances, we were not allowed to sample in one sector of the study area. **Conclusion.** From the results of the physicochemical and bacteriological analyzes it is concluded that the water extracted from the wells is not suitable for human use and consumption, since the levels of total dissolved solids and fecal coliforms exceed the maximum permissible limits of the NOM-127-SSA1-1994.

**Keywords:** irregular settlement; parameters; interpolation; statistical analysis.

### RESUMEN

**Antecedentes.** En la península de Yucatán, la fuente principal de abastecimiento de agua para todas las actividades humanas es el agua subterránea; no obstante, es altamente vulnerable a la contaminación debido a las características del acuífero kárstico, que permiten una infiltración directa y altamente susceptible al transporte de contaminantes. La misma dinámica se presenta en los sistemas insulares del oriente de la península, en específico en las islas de Holbox, Mujeres y Cozumel, siendo esta última la más poblada (casi 100 000 habitantes) y con presencia de asentamientos irregulares en las zonas de protección y captación de agua. **Objetivo.** Con el fin de comprender las características de la calidad del agua subterránea se busca muestrear, analizar y cartografiar el comportamiento espacial y temporal del recurso agua, así como determinar si existen diferencias significativas entre las temporadas de muestreo. **Metodología.** Para ello, se determinaron los sitios de muestreo a partir de las siguientes premisas: el número de personas residiendo en el lote, el número de años residiendo en el asentamiento, si cuenta con pozo de extracción para uso doméstico, si cuenta con bomba de extracción, si no tiene drenaje, si quema su basura y si en algún momento ha sufrido alguna

† Submitted May 30, 2020 – Accepted November 6, 2020. This work is licensed under a CC-BY 4.0 International License.  
ISSN: 1870-0462.



La Universidad de Quintana Roo  
a través de la  
**SECRETARÍA TÉCNICA DE INVESTIGACIÓN Y EXTENSIÓN DE LA  
DIVISIÓN DE DESARROLLO SUSTENTABLE**

Otorga la presente

*Constancia*

a:

**Wilbert Uh Yam**

Por haber impartido la Ponencia:

“Índice de vulnerabilidad a la contaminación del acuífero de sistemas kársticos en zonas costeras: Caso Playa del Carmen, Quintana Roo”, en el seminario de posgrado, realizado el 15 de diciembre de 2021.

17 de diciembre de 2021

  
DR. Carlos Alberto Niño Torres

Secretario Técnico de Investigación y Extensión

  
DRA. Lucinda Arroyo Arcos

Directora de la División de Desarrollo Sustentable