Water quality evaluation of the Akumal aquatic ecosystem (SE Mexico)

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INTRODUCTION

The dramatic increase in population growth is affecting the natural ecosystems in the area including the coral reef. The coral reef in Akumal, part of the Mesoamerican Barrier Reef system (the second largest after the Great Barrier Reef in Australia), makes this region very attractive for the tourism industry. Tourism activities have immediate and vast consequences for ecological systems, which are particularly vulnerable in this region. In addition, fractures and groundwater streams, characteristic of karst aquifers like those of Akumal mean that contaminants can be transported long distances with little dilution. Karst environments are highly vulnerable to a variety of degradation and pollution problems. As a consequence, water quality can deteriorate severely, which can result in very high economic and social costs in order to clean the polluted sites and restore the ecosystem. This study forecasts the water quality condition of the aquatic ecosystems of Akumal Quintana Roo, Mexico (20°23'46''N/ 87°18'50''W).
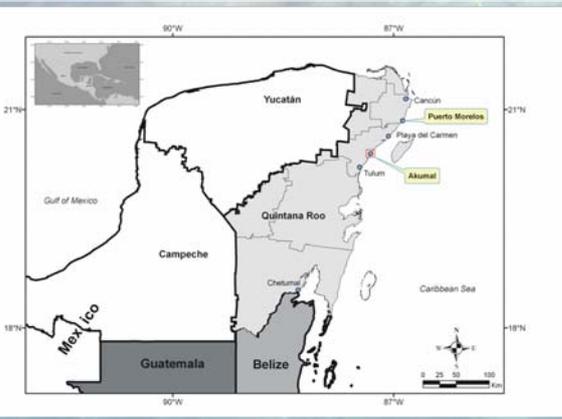
METHODS

Waters entering the Yal Kú estuary and Lagartos coastal lagoon were sampled and analyzed for physicochemical and bacteriological parameters. The Yal Kú estuary is the outlet for the main groundwater flows in the whole Akumal area. Water samples collected at seven locations in Yal Kú and four locations in Lagartos lagoon. The physicochemical measurements were performed by a data sonde, (Hydrolab®). Samples for bacteriological analysis (E. coli) were taken in sterilized bottles and analyzed the same day, no longer than 6h after collection. The Escherichia coli densities were determined in laboratory using Colilert method (IDEXX®).

RESULTS

Sea waters enters Yal Kú from the east, salinity of samples ranging from 15 to 35 ppt (Fig. 1). Three springs of fresh water entering the system were identified (YK2A, YK5 and YK7). The temperature varies between 25 and 30,0 °C degrees. The lower temperatures were in March and the highest in September. The results in some points of Yal Kú and Lagartos lagoon show coliform densities (E. coli) higher than the Mexican standard values (<200 MPN/100 ml) (Fig. 2 and 3). The level of E. coli in Yal Kú seems to be mainly associated with tourism activities. The pH for Lagartos lagoon and Yal Kú estuary is between 7 and 8.
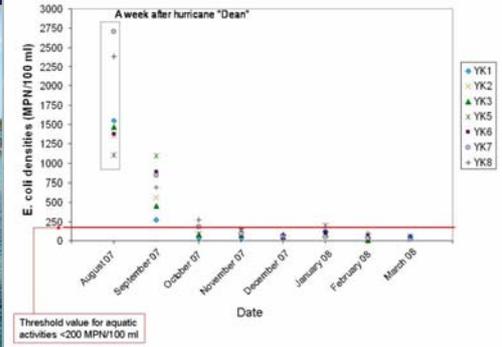

Yal Kú estuary

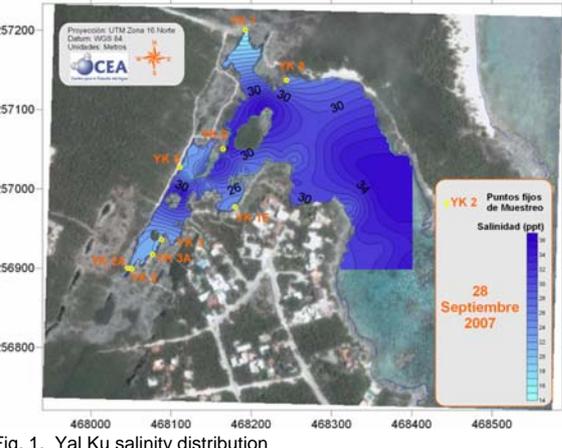Fig. 2 Seasonal distribution of E. coli densities in Yal Kú waters
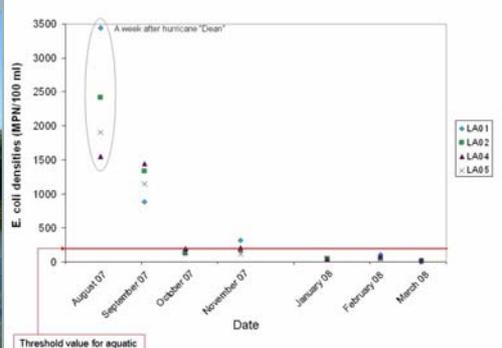

Fig. 1. Yal Ku salinity distribution

Lagartos lagoon

Fig. 3 Distribution of E. coli densities in Lagartos lagoon sampling points

CONCLUSIONS

- Different types of pollution characterize the different waters in Akumal. The impacts of toxic pollution on ecosystem health and hence on human health were tracked.
- Variations in water quality will increase the stress on available water resources and valuable ecosystems, especially the adjacent coral reef.
- Seasonal monitoring let us track the impact of events like hurricanes, wastewater discharges, etc., on the aquifer, as well as in the reef lagoon
- The results of this monitoring will provide baseline data to propose and/or improve waste water management and conservation measures as well as suggest further research on human health in the area.

REFERENCES

1. Back, W., Hanshaw, B.B., Pyle, T. E., Plummer, L. N., and Weidie, A. E. (1979). Geochemical significance of groundwater discharge and carbonate dissolution to the formation of Caleta Xel Ha, Quintana Roo, Mexico, Water Resources. Res., 15, 1521–1535
2. Doerfliger N., Jeannin P-Y., Zwahlen F. (1999). Water vulnerability assessment in karst environments: a new method of defining protection areas using a multi-attribute approach and GIS tools (EPIK method). Environmental Geology 39: 165-176
3. Parise M., Pascali V. (2003). Surface and subsurface environmental degradation in the karst of Apulia (southern Italy). Environmental Geology 44: 247-256
4. Shibata, T., Solo-Gabriele, H.M., Fleming, L.E., Elmir, S.M., (2004). Monitoring marine recreational water quality using multiple microbial indicators in an urban tropical environment. Water Res. 38, 3119–3131.