



Watershed to reef; working to help government and business understand the relationship between a clean aquifer and a healthy reef system

Since its founding in 1993, Centro Ecológico Akumal (CEA) has been working to create a model of sustainable tourism development in the Mexican Caribbean. Local hotel and property owners in Akumal, Quintana Roo dedicated a small piece of land on the beach, with an information center and the infrastructure sufficient to run a field station for conservation efforts in the region.

Besides being a small field station, in its fifteen years as a local institution, CEA has developed three main conservation programs (coastal marine, sea turtles, and water quality), and three management and outreach programs (environmental sustainability, environmental education and communication).

CEA was one of the several places around the globe hosting studies that were helping scientists to begin to understand the relationship between contaminated freshwater (pathogens and nutrients) and the health of coastal coral reefs. The organization was involved in a variety of studies, from looking at specific coral diseases to geological and hydrological studies of the watershed and aquifer in the coastal region.

From these early studies, CEA, along with other relevant institutions, began to educate and influence water management policies in the Riviera Maya. To date, the organization's efforts can be summarized as follows:

1) Understanding the aquifer through research

Because of the karstic land surface in the Yucatan Peninsula, there are no above-ground rivers in Yucatán Peninsula. The rocky soil is very permeable, allowing for most rainfall to filter to the subsoil into the aquifer below, through a system of fractures, sink holes and caverns.

Underground waters flow through this system, basically from the center of the peninsula towards the coastlines and into the sea through open outlets or fractures on the seafloor. This underground system has a direct influence on the land ecosystems, as well as an influence on marine and coastal ecosystems, such as the Mesoamerican Barrier Reef.

Thus, the aquifer is very fragile and vulnerable to all contaminants and at the same time, these elements threaten the balance between the various interrelated ecosystems throughout the peninsula.

Besides sharing experiences with other organizations and institutions, the research done by CEA or through CEA as a field station has allowed us to

understand better how the underground water is the common vehicle in the whole region, reflecting the quality of life of the ecosystems.

In the Akumal area, we have been able to carry out a census of many of the cenotes (sink holes) in the jungle, map part of the main underground rivers and caves along the coast and the links between the coastal lagoons and the cave system of the area.

However, there is still much to learn about the local aquifer to understand water flows under the whole area defined as Akumal. Likewise, as the urban area continues to grow, the impact of waste water on the underground water system must be understood better in order to improve management of the aquifer and reduce the negative impact of both untreated and treated waste water on the coral reef.

For more than ten years, several universities have been interested in the region and have come to Akumal as an ideal place to study the relationship between the aquifer and the reef. CEA serves as an excellent field station, with its dormitory, lab and office facilities, not only for its location, but because its community is concerned about the environmental and economic future of Akumal and sees in the organization, possibilities to improve local resource management.

In response to community interests, CEA has focused efforts on determining water quality parameters, the relationship between the freshwater and the coastal area and bays of Akumal; the direct links with the coral reef.

Since 2006, CEA, along with the Center for Scientific Research of Yucatan (CICY), began a permanent water quality monitoring project in the bays and lagoons of Akumal, which has demonstrated a slow but constant deterioration of water quality in these local bodies of water. These tests have helped us to demonstrate to the local hotel and tourism businesses as well as the government, the importance of integrated waste water management, bringing the importance of the water issue to the forefront of local policy issues.

In addition, through its work to certify Akumal's beaches, water testing was carried out over a twenty-four week period, as part of the federal government's "Clean Beaches" initiative, which establishes strict water quality parameters for coastal waters, among other criteria for beach quality certification. This process has three main elements: coastal infrastructure, environmental security, and hygiene. CEA is spearheading this initiative in Akumal with local property owners and hotels. This includes taking weekly samples to the state government labs in the state capital, establishing an integrated waste management program for the beach area and promoting public safety on the beach.

One of the main lessons learned from this process has been the need to establish an area-wide waste water treatment system, for the local town and hotel areas (at least 50% of the local waste water is not delivered to a treatment system before filtering or being injected into the aquifer).

As part of this effort, CEA has been able to maintain a small laboratory in which to carry out basic water quality research (seven main parameters), as well as provide a working space for visiting researchers. Each year we are working to improve the facilities, to be able to provide solid water quality studies for the area's hotels, researchers and as a factor for ecosystem quality for improved waste water management.

2) Sharing the findings through workshops and environmental campaigns.

The small town of Akumal has a diverse population; local residents who still do not understand the damage the aquifer has suffered or who consider it to be a necessary negative impact of tourism development; floating worker populations, and tourists, whose main goal is to enjoy their short time in the area.

Using past research, we have been able to develop educational materials to raise awareness, especially in local schools and with tourists. Likewise, we carry out workshops and waste management campaigns, and use video and printed material about good practices in water management.

3) Implementing and providing technological alternatives in solid and liquid waste management that ensure water quality in Akumal.

Akumal was the first tourism destination developed along the Mexican Caribbean coastline (it will be fifty years old in 2009) and it has been characterized as a low-impact destination because of the community's interests and CEA's local work, in comparison to other areas on the Mexican coast.

However, the area has had limited waste water treatment, without local systems, and thus the coastal ecosystems have suffered from localized pollution. Given this reality, CEA has tested and promoted the installation of artificial wetlands as tertiary waste water treatment (55 systems in Akumal to date). We have also promoted the use of composting toilets and solid waste recycling in Akumal and through regional workshops with the public and private sectors for greater use of these technologies.

4) Leading with local authorities and communities for sustainable management of the aquifer of Quintana Roo.

The local town has a small waste water treatment plant run by the municipal government, however, it is not sufficient to address the needs of the houses that are connected to it, and at least one half the town is still without proper drainage. Moreover, both untreated and treated waters are injected into the subsoil, reaching and polluting the aquifer. In response to these threats to human and reef health, CEA has worked over the past two years to establish a strategy to install treatment plants for the entire Akumal region, first through

raising awareness of the problem, then by working with local residents and government officials to define and finance a "connection strategy".

Given that the waste water management system and plant in the town are not sufficient to treat all the waste water produced, contaminants continue to reach the local aquifer. The water that is treated in both the urban area and at large hotels is deep-injected into the ground and enters the aquifer. This is one of the reasons we have detected pathogens in the water in Akumal, and the main reason we are working with the authorities and local businesses to design a system to completely treat the waste water produced here. We are working to implement necessary actions to more quickly reduce the amount of contaminants reaching the underground rivers in the area and then the coral reef.

The sum of these efforts represent a very clear objective – reduce contamination to the micro-watershed for the Akumal community. This includes working with the public and private sectors to improve waste water management as well as apply alternative technologies that promote the sustainable development of Akumal.

So far, we have been able to understand the direct relationship between water quality in the coastal aquifer and the coral reef running along the coast; demonstrate alternative technologies for waste water treatment; and inform the public and authorities of threats and solutions to address this problem.

However, CEA must continue to strive to close the sources of underground water pollution if we hope to protect the coral reef; the basis of the local economy. The environmental quality of this tourist destination will determine its economic future. With the support of continued program funding, CEA is certain to be able to reach its goal of clean water and a healthy reef, not only because of the organization's qualified staff, but because of the support of government institutions and the community. With an accredited water laboratory, the wastewater treatment strategy implemented and improved water management educational materials, CEA is sure to consolidate its Water Quality Program to serve the entire community for years to come.

By achieving this objective, Akumal can become the model for other tourist destinations and urban areas along Mexico's Caribbean coast, demonstrating that economic development of an area does not have result in environmental destruction.

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