

L a g u n a B a c a l a r I n s t i t u t e S y m p o s i u m
Bacalar, Quintana Roo, Mexico
Friday 9 January 2009

9:15 am Welcome and Introductions, Jerry 'River' Kaster, UW-Milwaukee

Prof. Kaster welcomed participants and guests and compared Laguna Bacalar to several “world class” lakes: Lake Tanganyika, Lake Titicaca, Lake Baikal, and the Great Lakes. Prof. Kaster said that Laguna Bacalar is in the same category as these lakes, based upon its unique bio-geo-chemistry, submarine cenotes, terrestrial cenote connections to submarine cenotes, and its biodiversity. The lake, noted Kaster, is a leading indicator of the ecological health of the region.

9:25 am Francisco Javier Díaz Carvajal, representing Q. Roo Governor Félix González Canto

Mr. Carvaja conveyed the governor’s greetings and offered his regards to all attendees. Carvaja noted that a variety of planning documents are already in place to guide the lake’s development and that the various governmental agencies were acting to support economic and environmental sustainability. The year 2009 should see additional funding to repair the town roads destroyed by the sewer main installations, to complete the sewer system and begin processing effluent, and to open a new solid waste disposal site (dump) for Bacalar.

9:50 am Bacalar Pueblo Magic: What is in a Name? Arturo Borrego, EcoTucan, Bacalar

Mr. Borrego, president of Bacalar Magico committee, recounted his longstanding personal history with Laguna Bacalar and then described Bacalar’s entry into the Pueblo Magico program. The program provides governmental funding for infrastructure projects such as the sewer system initiated a year ago. Pueblo Magico funding is directed to and managed by the Alcaldia of Bacalar, noted Mr. Borrego. He also observed that Pueblo Magico committee members felt that funding was needed for publicity and advertising and also that there was a strong need to balance the infrastructure activities undertaken by the Alcaldia against protection of the lake.

10:00 am Cultural History of the Bacalar Region, Juan Manuel Espinoza, Universidad de Quintana Roo

Prof. Espinoza shared some facts about Bacalar’s history, including that there have been two towns named Bacalar, the first founded in 1543 and later reclaimed by the jungle. The current church was originally built of wood, but burned and was replaced with the stone structure found on 5th Ave. today. Bacalar is one of four Hispanic settlements in the Yucatan, along with Merida, Campeche, and Valladolid. In 1644 Bacalar was attacked by pirates; in 1729 the Fort was constructed, using stones taken from much older Maya constructions. For many years, Laguna Bacalar was a place of ship building, due in part to the availability of lumber and access to the Caribbean.

10:10am: Natural History of Laguna Bacalar, Jim Bacon, Bacalar Nature Services, Bacalar

Mr. Bacon provided a slide show with photos of most of the signature animals and plants of Laguna Bacalar. He noted that the lake is unusual in its population of snails and the limpkins and snail kites that feed upon them. Mangrove and buttonwood trees dominate the shore and while many species of saltwater fish occasionally make their way to the lake, the fish population is predominantly cichlids.

**10:20am Hydrological Importance and Connection of Bacalar with the Sian Ka’an Biosphere
Gonzalo Merediz Alonso, Amigos de Sian Ka'an**

Mr. Alonso provided preliminary findings of a project that is using aerial, electromagnetic sensors to capture data about underlying geological formations in the Yucatan and specialized software to interpret and model the data. Initial focus in on the Tulum area, where significant existing mapping by divers provides a ready base for validating the applicability of the technology and for refining the

modeling process. Building upon technology developed at the Technical University of Denmark and the Austrian Geological Survey, a detailed map of the underground rivers of the Yucatan is being developed. Of note is the preliminary finding (a hypothesis to be confirmed through more research) that Laguna Bacalar is connected in a very direct way and as one source of the aquifers of Tulum. Amigos de Sian Ka'an is working with a wide array of sponsors, government agencies, and in-kind suppliers in an effort to expand this proof-of-concept mapping (now 100 square kilometers) to the Yucatan as a whole, focusing on areas where land fragmentation and population growth put clean waters at risk.

11:20am Sustainable Development - Maintaining Paradise

Paul Sánchez-Navarro, Centro Ecológico Akumal

Mr. Sánchez-Navarro highlighted the fact that, for much of Quintana Roo, what is being marketed to tourists is "paradise" and that the sale of "nature" as a product has a wide variety of implications. He noted that there are few easy ways of balancing economic, environmental and social concerns, particularly because these concerns are addressed by diverse, un-coordinated activities of governmental agencies, local citizens and business people, NGOs and others. Mr. Sánchez-Navarro observed that 16% of Mexico's surface area receives some form of protection and that it is in these areas that the biggest issue of the day -- waste water management -- stands the best chance of being successfully addressed.

2:00pm: Sustainable Ecoturismo at Laguna Bacalar, M.C. Jorge R. Chavez, Ecoturismo TAP

Dr. Chavez presented background information on global ecological changes as well as highlighted some of the important areas of focus for Laguna Bacalar. He described a high-level framework for analyzing sustainability issues, noting that the United Nations defines resource sustainability as use that avoids any degradation in the ability of next generations to live, work and play – in this case – in and around Laguna Bacalar.

02:30pm Waste Water Treatment and Strategic Planning, Ray Grosch, Intellisys-is

Mr. Grosch emphasized the unusual circumstance of Bacalar in which the aquifer and the surface area are a continuous, connected flow and this makes the risk of contamination greater than in most communities, particularly from storm runoff. He noted that any system for managing septic wastes needs to be not only planned, engineered, and developed carefully, it must be operated properly and the outcome must be both validated and documented. Mr. Grosch provided an overview of conventional sewer systems: simple gravity fed, grinder/pump systems, vacuum systems, and distributed systems.

02:50pm Microbial Ecology of Submerged Cenote Ecosystems in Lake Huron

Bopaiah Biddanda, Grand Valley State University, Michigan

Prof. Biddanda described his study of three submarine cenote ecosystems of differing depths. One is shallow, permitting substantial light to penetrate it. One is medium depth, filtering a significant amount of light. The final is deep, permitting only a small percentage of light to penetrate. Prof. Biddanda found that photosynthesis was the dominant process in the shallow cenote, that a hybrid of photosynthetic and bio-chemical processes in the medium-depth cenote, and the deep-water cenote had almost exclusively bio-chemical processes. He and Prof. Kendall are making preliminary measurements of cenotes in Laguna Bacalar to capture sample data and begin planning baseline limnological studies.

03:45pm Habitat Mapping of a Submerged Cenote in Lake Huron

Scott Kendall, Grand Valley State University, Michigan

Prof. Kendall described his work in a submarine cenote in Lake Michigan and how many of the same techniques and tools used there are applicable to studying Laguna Bacalar. In the Michigan cenote, subterranean flows mix with lake water in a bowl-shaped depression, unlike the cylinder-shaped

cenotes in and surrounding Laguna Bacalar. pH and conductivity measurements are critical to understanding mix and flow of waters and the bio-geo-chemical submarine environment. He and Prof. Biddanda are making preliminary measurements of cenotes in Laguna Bacalar to capture sample data that could be used to begin planning baseline limnological studies.

04:15pm: Ecological Early Warning for Laguna Bacalar: The Black Striped Mussel River Kaster, UW-Milwaukee

Prof. Kaster described the significant and costly invasion of the Zebra Mussel into important fresh-water systems such as the Great Lakes as well as salt-water harbors, ocean shipping, and municipal and industrial infrastructure. He noted that the Black Striped Mussel (a species with similar impact commonly found in the Caribbean) had invaded Laguna Bacalar, possibly during hurricanes or as a result of boat traffic. Today, the lake's mussel population is stable, observed Kaster, suggesting a nutritional limit to growth. Because the mussel is a voracious and successful feeder of nitrogen, increased mussel population growth may serve as an early-warning sign of the lake's deterioration due to wastewater and run off.

04:40pm Microbialite Overview, Robert Ginsburg, University of Miami, Florida

Prof. Ginsberg noted that stromatolites are believed to represent the earliest form of life on earth, as cyanobacteria from the Precambrian period 2.5 billion years ago; and that the Holocene-era stromatolites found at numerous sites in and around Laguna Bacalar were remarkably similar in appearance those ancient life forms. The nearly identical morphology of the microbialite structures from the two eras is "strong support for using Holocene stromatolites as guides to interpreting the morphology and depositional environment of some Precambrian examples," observed Ginsberg. The stromatolites represent an extremely rare life/geological form worthy of extensive study and Prof. Ginsberg suggested that many scientists will be interested in visiting Bacalar and studying these unusual structures.

L a g u n a B a c a l a r I n s t i t u t e S y m p o s i u m

Saturday, January 10

11:00am Environmental Characteristics, Population and Current Situation of the Natural Resources of Laguna Bacalar during the Holoceno

Adriana Yoloxóchitl Olivera Gómez, Grupo Ciudadano Ambiental en Manejo de Recursos Costeros A.C.

Prof. Gomez described the recent geological history of Laguna Bacalar and the area surrounding. 3000 years ago, an earthquake caused a significant uplift and a tsunami of liquid soil that changed the nature of the lake area dramatically. Sometime between 50 BC and 100 AD, settlements of Maya were established. Between 250 AD and 1540, Chactemal was capital of the Maya province stretching from Belize and the Rio Hondo to north of Bacalar. Sian Ka'an Bakjalal (the Maya name for the town) was the capital of Uyamil (one of 16 Maya city-states in the Yucatan.) Even today, primarily-Mayan ejidos along the lake continue to play an important role in the region's civil administration and agricultural production.

11:45am Laguna Bacalar Research

Martin Maas Vargas, COBACH, Laboratorio de Usos Múltiples, Bacalar

Prof. Maas has been working for five years with local high-school students to monitor a series of aspects of Laguna Bacalar chemistry and biology. Data has been collected from a number locations along the lake from Xul-ha to north of Bacalar Pueblo. Temperature, turbidity, pH, phosphates, coliform, nitrates and dissolved oxygen have been measured. Maas notes three changes that are somewhat uniform

across the sample locations: pH, coliform, and phosphates are all up, suggesting the effects of wastewater disposal.

12:15am Laguna Bacalar Focus – CONAGUA Regional Director, Juan Ramon Diaz Caldron

Engineer Caldron area of focus is on water quality and standards and his department is engaged in a 18 or so short-term (five years or less) projects that bring immediate benefit in terms of protecting, preserving, or reclaiming freshwater systems. One of these projects is in Bacalar and is similar in scope to the POET study. Over the next eight months, with support from a Merida consulting firm, the project will identify the stakeholders of the region, characterize the current state of the waterways, and prepare a plan and budget for the execution of the selected activities and projects. Caldron highlighted the ten meter Federal Zone lying onshore next to the lake as a critical resource.

2:00pm The Confusing and Mysterious World of Modern and Ancient Stromatolites, Kenneth Neelson, J. Craig Venter Institute and the University of Southern California

Prof. Neelson observed that geology and microbiology are interconnected and provided examples of purely bacteriological processes that yielded geological deposits difficult to distinguish from stromatolites. He noted that there are very few places on the earth where stromatolites are still known to be living and that Bacalar is one. Prof. Neelson attributed the lake's very thick layer of carbonate sediment to precipitation that is caused as low-level cenote water rises to the surface and increases in pH. In closing, he described a "fuel cell" his USC team is working on that uses specialized bacteria to convert septic sludge to pure water and electricity with no other energy sources or by-products.

03:00pm Giant Holocene Freshwater Microbialites of Laguna Bacalar, Quintana Roo, Michael Gibson, University of Tennessee at Martin

Prof. Gibson has been studying the stromatolites of Laguna Bacalar for ten years, working initially directly offshore at Cocolitos campground on the south of Ave. Costera. Stromatolites were once thought to be purely geological evidence of historical life, but Prof. Gibson has demonstrated that the stromatolites here in Bacalar are alive: they are literally living rocks. He notes that stromatolites, much like other geological artifacts, can yield a detailed history of environmental events over many hundreds and possibly thousands of years. Thusfar, Prof. Gibson's research suggests that stromatolites thrive in proximity to cenotes; he plans of broader exploration of the lake to determine if other concentrations can be found with similar proximity to cenote flows.

04:05pm Mangrove Ecology and Reproductive Systems Beverly Rathcke, University of Michigan

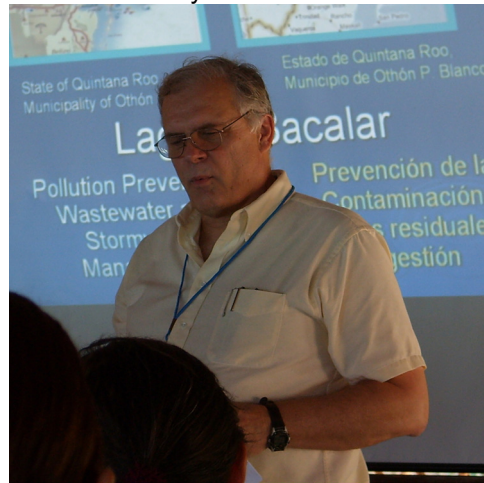
Prof. Rathcke observed that of the 50 world-wide species of mangrove trees, three are found naturally along Laguna Bacalar and in the nearby region: red mangrove, black mangrove and white mangrove. Mangroves are salt-tolerant, thus can survive in brackish or salt water and are found along the estuaries that lead from Bacalar to the Caribbean. In general, red mangrove lies closest to the shore with its roots wet in the water. Behind it, in muddy or dry soil is found the black mangrove. And furthest from the water and on generally dry land is found the white mangrove. Mangroves are considered the most valuable plant for coastal regions because they not only protect the land from erosion due to hurricanes, flooding and storms, they capture and build soil, filter water of sediments and pollutants, and provide a productive marine ecosystem.

Laguna Bacalar Institute Symposium 9-10 January 2009

Paul Sanchez-Navarro



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Bopiah Biddanda



Scott Kendall



Gonzalo Merediz-Alonso



Ken Neelson

