

The relationship between land use and sedimentation processes in two bioluminescent bays of Puerto Rico



Fernando Gilbes¹ and Roy Armstrong²
¹UPRM-Department of Geology, gilbes@cacique.uprm.edu
²UPRM-Department of Marine Sciences, roy@cacique.uprm.edu

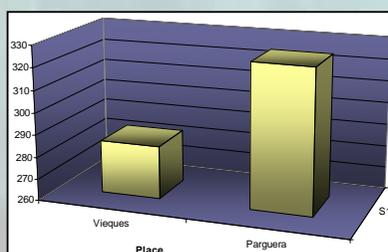


Project Summary-Puerto Mosquito Bay is one of the most magnificent examples of the world's few remaining bioluminescent bays. It lies within a basin formed along the southern edge of volcanic upland that comprises much of the bedrock of Vieques. Bioluminescence (the emission of light by living organisms) in Puerto Mosquito is caused almost exclusively by microscopic phytoplankton called dinoflagellates. This splendor of light may be in peril due to the unsustainable human activities in the surrounding uplands and along the shoreline of this shallow marine environment. With the increased tourist activities and the current development practices within the surrounding area, bioluminescence in this bay may be at risk in the near future resulting from excessive erosion and deposition of sediments and contaminants. The main objective of this work was to evaluate the relationship between physical parameters, sediment composition, and land use-land cover of the area by using traditional sampling methods and remote sensing. Sediment was collected monthly over an eight months period using three sediment traps located in the bay. Sediment composition, X-Ray Diffraction, sieving and serigraph analyses were part of the methodology. Temperature measurements were also registered at each trap. The analyses demonstrate that 45% was carbonate material, 33% was terrigenous material, and 22% was organic material. The results from Puerto Mosquito Bay were compared with the same type of data collected during the same period in La Parguera Bioluminescent Bay in Lajas, Puerto Rico. In La Parguera the carbonate material was only 10%, while terrigenous material was 65% and the organic material was 25%. This study clearly demonstrates that La Parguera Bay received much more terrigenous material than Vieques Bay during the studied period, suggesting important differences in the processes affecting the sedimentation. In order to evaluate this problem IKONOS images were used to determine the changes in Land Use and Land Cover of the surrounding areas in both bays. The analyses showed that La Parguera has less vegetation and more human activity closed to the bay than in Vieques. Such condition in combination with the geology of the areas could explain the sedimentation trends found during this study.

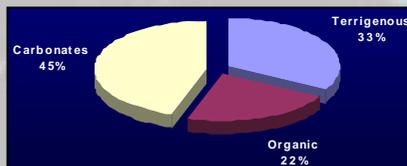
STUDY SITES



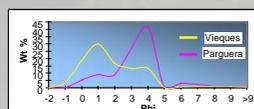
RESULTS



Average Collected Sediments (grams)



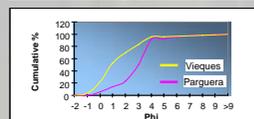
Grain size in Vieques and Parguera Bays



-Puerto Mosquito Bay had coarse and medium grain size ($\Phi=0$ and 1).

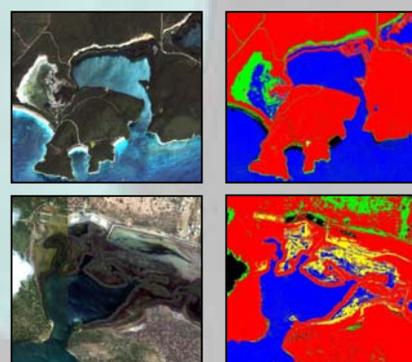
-La Parguera Bay had very fine grain size ($\Phi=3$ and 4).

-The results suggest that there is a process in La Parguera that favors the movement and deposition of very fine grains.



Grain size in Vieques and Parguera Bays

IKONOS IMAGES



OBJECTIVES

- Evaluate the impact of sedimentation processes.
- Determine the land use and land cover of the area by using image processing and GIS.
- Evaluate the latest technology in field sensors for measuring bioluminescence.
- Compare the conditions in Puerto Mosquito Bay and in La Parguera Bay.

PROCEDURES

Sediment traps: Traps were made with 15 cm wide and 15 cm long PVC tubes with a rod of 2 cm wide and 1 m long for stabilizing the trap in the bottom. They were placed at three different locations in both bays. The collected sediment was recovered every month during one year period.

Sediment composition: The collected samples were washed with Clorox until the fezzes stopped, dried and weighed. The lost material was the organic fraction. Then, they were washed with HCl at 10%, this process takes the carbonate fraction away, the sample was dried and weighted again. Everything left were terrigenous materials.

Grain size: The samples were sieved and serigraph analyses were made.



FIELD SENSORS

GLOWtracka (1): A flow meter that stimulates bioluminescent organisms – principally dinoflagellates. The instrument then measures the light flashes as the organisms pass the detector. The complete range of flashes that can occur – from single events to mesoscale – is measured.

Solid State Bathy-Photometer (2): A sensor that creates a turbulent flow of water through a viewing chamber to produce measurable bioluminescence. This instrument is under development and we are making arrangements to test it in the study sites.



CONCLUSIONS

- La Parguera Bay received much more terrigenous material than Vieques Bay during the studied period.
- This suggests important differences in the processes affecting the sedimentation.
- GIS analyses showed that La Parguera has less vegetation and more human development closed to the bay than in Vieques.
- Such conditions in combination with the geology of the areas could explain the sedimentation trends found during this study.

PRACTICAL APPLICATIONS

- Provide geographically located data for Mosquito and La Parguera Bays required for ecosystem – based management.
- Develop new techniques for rapid assessments of the bioluminescent populations using optical and remote sensing data
- Develop a database for GIS applications.

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