

ASPIRE: Community Enhanced Monitoring and Research of Puerto Rico's Bioluminescent Bays

Coastal lagoons and their surrounding mangrove wetlands are important for the economic, social, and cultural well-being of coastal Puerto Ricans. They are home to important food resources (e.g. crabs, oysters, clams, estuarine fish species like mullet, drum, mojarras; snook; picudilla) and provide habitat and/or food resources for many economically important marine fishery species at various stages in their ontogenetic development, thus forming part of the connected ecosystem that supports tropical fisheries (Mumby et al. 2004; Robertson and Duke 1990; Koenig et al. 2007; Nagelkerken et al. 2008) and tourism (Brusi 2004; 2008).

Bioluminescent bays (hereafter BioBays) are a specific subset of these lagoon systems, where bioluminescent dinoflagellates (*Pyrodinium bahamense* var. *bahamense*) dominate the plankton community and persist for much of the year, providing a unique tourism resource.

There are three BioBays identified within the archipelago of Puerto Rico (Figure 1). As with other components/features of the coastal lagoon systems, coastal Puerto Ricans have interacted productively with BioBays in a variety of ways, in particular by developing small-scale but robust tourism operations based on bringing tourists to enjoy night-time viewing of the bioluminescence. BioBays such as those in Parguera, Vieques, and Fajardo have been sources of revenue to the coastal communities and provide income to local tour guide operations, traditionally run by locals with knowledge of the coastal landscape, mostly fishermen and/or their kin (Brusi 2004; 2008). Other coastal businesses, such as seafood eateries and souvenir shops, also receive revenue from BioBay tourism near these sites. Even for those coastal residents who do not receive direct income, local BioBays are often a source of pride and part of their sense of place and cultural heritage. Thus, BioBays are sources of both economic and non-economic (symbolic) value for coastal populations.

Despite a keen understanding of the importance of the BioBays for local economics and much information on the biology of the *P. bahamense*, little information has been collected to characterize the role of oceanography in the ecology of these bays or the impact various environmental pressures have on the system. Studies in these lagoons have shown that favorable wind conditions coupled to the behavior of *P. bahamense* may concentrate the cells in regions of retention within the lagoons and bays where they were found to dominate (Seliger et al. 1970). Seliger et al. (1971) suggested that changes in nutrient concentrations may have resulted in shifts to species other than *P. bahamense* in Parguera, a lagoon that “lost” much of its bioluminescence, even if the oceanography of the system was not altered appreciably. More recently, Sastre et al. (2013) and Soler-Figueroa & Otero (2015) showed how nutrients, linked to meteorological patterns during wet and dry seasons, may play a role in the dominance of *P. bahamense* in relation to other members of the microplankton community. Further, hydrographic and meteorological conditions may affect the overall bioluminescence of the BioBays (Soler-Figueroa & Otero 2016), though the direct relationships have not been well defined. Two recent comparative studies have examined similarities and differences between specific BioBays in Puerto Rico, those found in Parguera and on the island of Vieques (Walker 1997; Soler Figueroa 2006), and the findings indicated that nutrients did not vary significantly between the systems, but Parguera had a more diverse dinoflagellate community dominated by a non-bioluminescent dinoflagellate.

Here we propose the formation of a Mobile Working Group (MWG) to develop a plan for sustainable monitoring of the BioBays, utilizing local expertise and resources, in an effort to preserve the important economic and natural resource of the BioBays in these communities.

The proposed BioBay MWG will consist of local small business owners (BioBay kayak guides), local NGOs who operate in and around the BioBays, and geoscientists familiar with the systems. To achieve the goals of the BioBay MWG, we will conduct two listening sessions for all stakeholders and geoscientists involved in the project to facilitate a virtuous exchange among the interested parties. The first listening session will be aimed at determining the major challenges facing the stakeholders and the system itself, and the second will be to finalize details of the consensus based monitoring efforts that were developed by the MWG. The Boundary Spanner will be Juan Alvarez, a native of Puerto Rico and currently a PhD student at the University of Maryland Center for Environmental Scientists, whose dissertation topic is focused on the ecology, biogeochemistry, and oceanography of two BioBays in Puerto Rico. Anticipated products from this BioBay MWG are: 1) a community-based monitoring plan for two BioBays, Laguna Grande in Fajardo and Puerto Mosquito in Vieques, that incorporate participatory citizen scientists at all stages of the design and implementation of the plan; and 2) a new network of stakeholders and citizen scientists with the resources to share data and ideas to sustain the monitoring plan, and including a collaborative online resource library containing media pertaining to the ecology, cultural significance, and economy of the BioBays that is made available to all stakeholders. *The major outcome from the BioBay MWG we hope will be the 3 means for consensus-based management of the BioBay resources, based on community enhanced and expert-informed monitoring and analysis.*